



SPICER®
Off-Highway Products

Service Manual

Transmission
2+3

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TOWING OR PUSH STARTING

Before towing the vehicle, be sure to disconnect both front and rear drivelines to avoid damage to the transmission during towing.

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the SPICER OFF-HIGHWAY product.

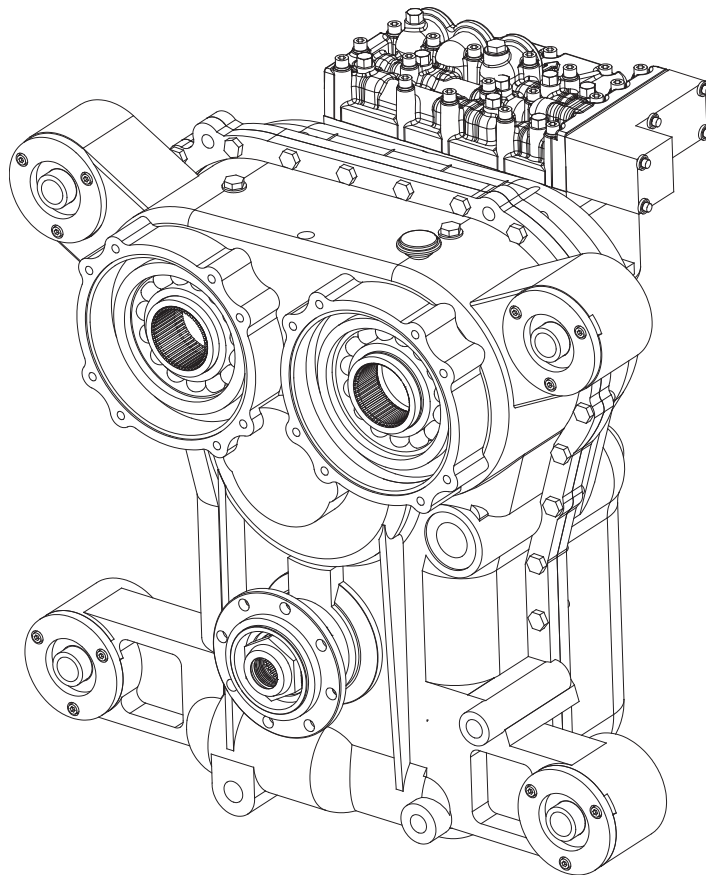
Extreme care has been exercised in the design, selection of materials and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the product, its principle of operation, troubleshooting and adjustments, it is urged that the mechanic studies the instructions in this manual carefully and uses it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required, only SPICER OFF-HIGHWAY PRODUCTS approved parts as listed in the applicable parts manual should be used. Use of 'will-fit' or non approved parts may endanger proper operation and performance of the equipment. SPICER OFF-HIGHWAY PRODUCTS does not warrant repair or replacement parts, nor failures resulting from the use of parts which are not supplied by or approved by SPICER OFF-HIGHWAY PRODUCTS.

IMPORTANT:

ALWAYS FURNISH THE DISTRIBUTOR WITH THE SERIAL AND MODEL NUMBER WHEN ORDERING PARTS.



SAFETY PRECAUTIONS

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

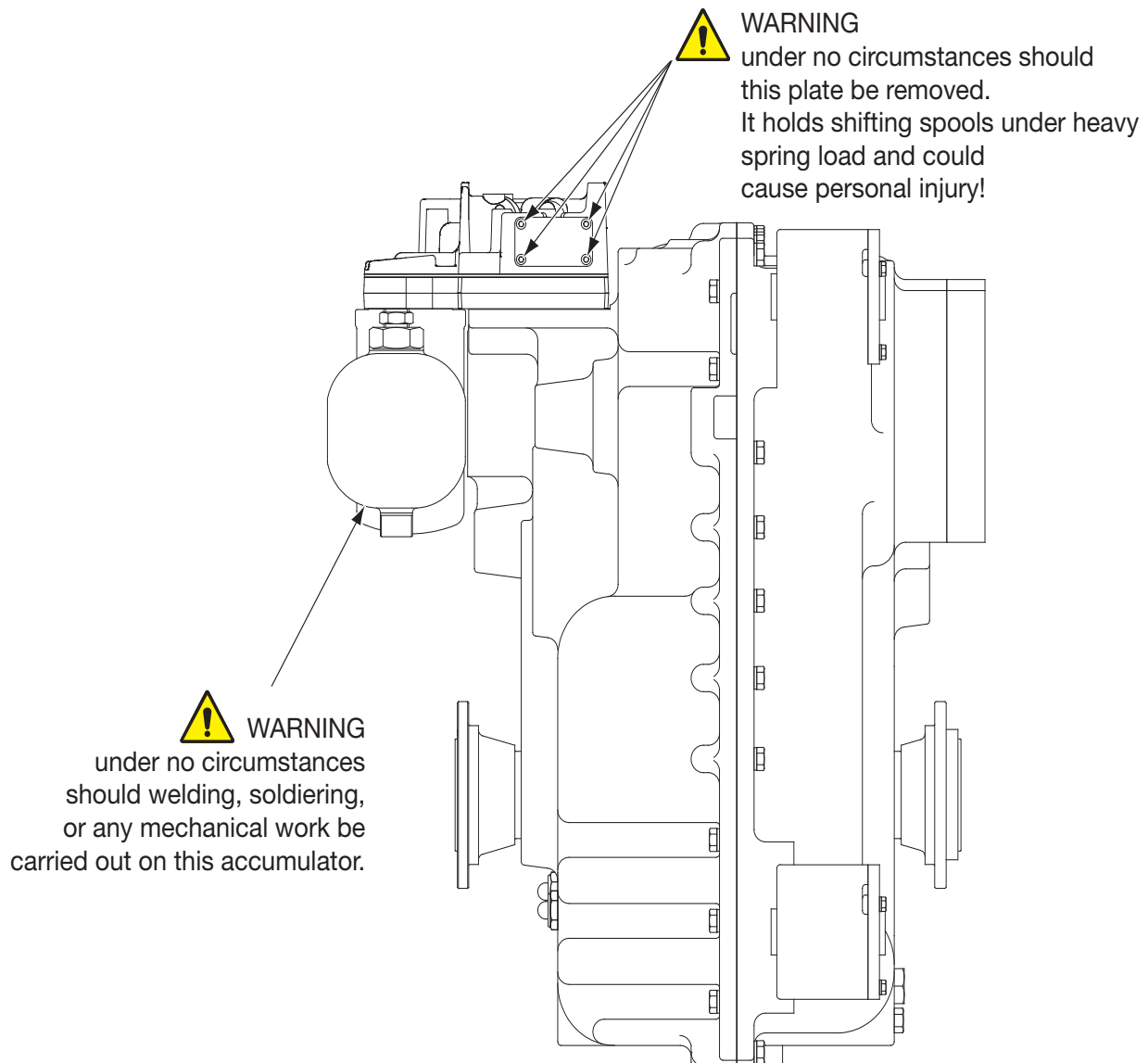
Proper service and repair are important to the safety of the service technician and the safe reliable operation of the machine. If replacement parts are required the part must be replaced by a spare part which has the same part number or with an equivalent part. **DO NOT USE A SPARE PART OF LESSER QUALITY.**

The service procedures recommended in this manual are effective methods for performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly, anyone who intends to use a spare parts, service procedure, or tool, which is not recommended by SPICER OFF-HIGHWAY PRODUCTS, must first determine that neither his safety nor the safe operation of the machine will be jeopardized by the spare part, service procedure, or tool selected.

IMPORTANT:

This manual contains various cautions and notes that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the unit or render it unsafe. It is also important to understand these cautions and notes are not exhaustive, because it is impossible to warn about all the possible hazardous consequences that might result from failure to follow these instructions.



CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION

Care should be exercised to avoid skin rashes, fire hazards, and inhalation of vapours when using solvent type cleaners.

BEARINGS

Remove bearings from cleaning fluid and strike flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. **DO NOT SPIN BEARINGS WHEN DRYING.** Bearings may be rotated slowly by hand to facilitate drying process.

HOUSINGS

Clean interior and exterior of housings, bearing caps, etc... thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION

Care should be exercised to avoid inhalation of vapours and skin rashes when using alkali cleaners.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft lintless absorbant wiping rags, free of abrasive materials such as metal fillings, contaminated oil or lapping compound.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

BEARINGS

Carefully inspect all rollers, cages, and cups for wear, chipping, or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in automatic transmission fluid and wrap in clean lintless cloth or paper to protect them until installed.

OIL SEALS, GASKETS, ETC.

Replacement of spring load oil seals, o-rings, metal sealing rings, gaskets and snap rings is more economical when the unit is disassembled than premature overhaul to replace these parts at a future time.

Further loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching or curling under of lips of seals seriously impairs its efficiency.

When assembling new metal type sealing rings, these should be lubricated with a coat of chassis grease to stabilise rings in their grooves for ease of assembly of mating members. Lubricate all o-rings and seals with recommended type automatic transmission fluid before assembly.

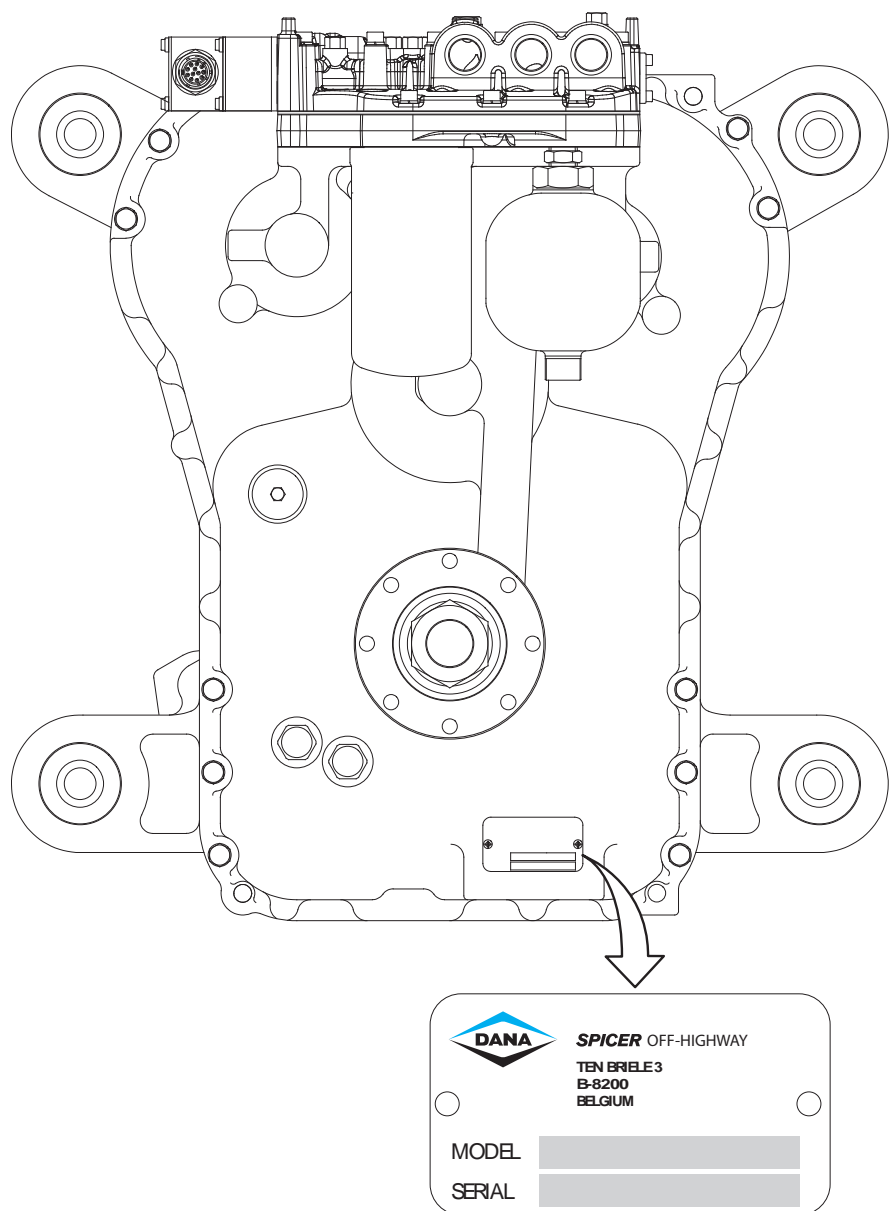
GEARS & SHAFTS

If Magna-Flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they are not sprung, bent or spline-twisted, and that shafts are true.

HOUSINGS, COVERS, ETC.

Inspect housings, covers and bearing caps to ensure they are thoroughly clean and mating surfaces, bearing bores, etc... are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which would cause subsequent oil leaks or failures.

TECHNICAL SPECIFICATIONS



IDENTIFICATION OF THE UNIT

- 1 - Model and type of the unit
- 2 - Serial number

WEIGHT, DIMENSIONS, & OIL CAPACITY

WEIGHT, DIMENSIONS, OIL CAPACITY	
Weight (dry)	285 kg [627 lb.]
Maximum length	576.8 mm [22.71 inches]
Maximum width	688.0 mm [27.09 inches]
Maximum height	713.0 mm [28.07 inches]
Oil capacity	±11 l (2.9 US Gallon) without cooler and hydraulic lines

TECHNICAL SPECIFICATIONS

PRESSURE AND TEMPERATURE SPECIFICATIONS

Normal operating temperature	158 - 248°F [70 - 120°C] measured at temperature check port converter out port 71 **
Maximum allowed transmission temperature	248°F [120°C]
Regulator Pressure *	Vehicle in Neutral & Port 31 ** At 700 RPM (engine) 17 bar [247 PSI] minimum At 2200 RPM (engine) 23.1 bar [335 PSI] maximum
Pump flow *	At 750 RPM (engine): 10.7 l/min. minimum [2.8 GPM] At 2000 RPM (engine): 34.2 l/min. minimum [9.0 GPM] At 2200 RPM (engine): 49.4 l/min. minimum [13 GPM]
Clutch pressures *	1st clutch: port 41 ** 2nd clutch: port 42 ** 3rd clutch: port 43 ** At 700 RPM: - 14.2 bar [206 PSI] minimum if clutch activated At 2200 RPM: - 18.3 - 22.3 bar [265 - 323 PSI] minimum if clutch activated - 0 - 0.2 bar [0 - 3 PSI] minimum if clutch released
Solenoid pressure	8.5 - 11.5 bar [123 - 167 PSI]
Filter bypass valve *	set at 4.1 - 4.5 bar [59 - 65 PSI]
Lube pressure *	Port 33 0.8 - 1.1 bar [12 - 16 PSI] at 22.6 l/min. [6 GPM] pump flow
Safety valve: cracking pressure *	6.5 - 10 bar [94 - 145 PSI]
Cooler bypass	4.1 - 6.4 bar [59 - 93 PSI]

* All pressures and flows to be measured with oil temperature of 180 - 200°F [82 - 93°C]

** Refer to TROUBLESHOOTING p. 32 for check port identification

ELECTRICAL SPECIFICATIONS

Solenoid	Forward, Reverse, 1st, 2nd 3rd and modulation Coil resistance 12V: 28 Ω \pm 2 Ω Coil resistance 24V: 93 Ω \pm 6 Ω
Speed sensor	Type: Inductive Sensing distance: 0 - 0.6 mm (0" - 0.024") Coil resistance: 1050 Ω \pm 100 Ω

TECHNICAL SPECIFICATIONS

HYDRAULIC COOLER LINE SPECIFICATIONS

Lines and fittings (Minimum	.59" [15 mm] internal diameter
Continuous Operating Temperature	Ambient to 248°F [120°C]
Continuous Pressure	20 bar [290 PSI] continuous pressure and 40 bar [580 PSI] intermittent surges
Conformance	SAE J1019 and SAE J517, 100RI

SUCTION LINE SPECIFICATIONS

Lines and fittings (Minimum	1.25" [32 mm] internal diameter
Continuous Operating Temperature	Ambient to 248°F [120°C]
Continuous Pressure	20 bar [290 PSI] continuous pressure and 40 bar [580 PSI] intermittent surges
Conformance	SAE J1019 and SAE J517, 100RI

MAINTENANCE

OIL SPECIFICATION

Automatic Transmission Fluid (ATF) oil which only meets following specifications:

- ATF Elfmatic G3
- Texaco Texamatic 7045
- Shell Donax TA
- Pennzoil

MAINTENANCE INTERVALS

DAILY

Check oil level daily with engine running at idle (750 RPM) and oil at 180 - 200°F [82 - 93°C]

Maintain oil level at FULL mark.

NORMAL DRAIN PERIOD

Normal drain period and oil filter change are for average environment and duty cycle conditions.

Severe or sustained high operating temperature or very dusty atmospheric conditions will cause accelerated deterioration and contamination.

For extreme conditions judgement must be used to determine the required change intervals.

- Every 1000 hours change oil filter.
- Every 1000 hours drain and refill system as follows:

Drain with oil at 150 - 200°F [65 - 93°C].

1 - Drain transmission

2 - Remove and discard filter.

3 - Install new filter.

4 - Refill transmission to FULL mark.

5 - Run engine at idle (750 RPM) to prime lines.

6 - Recheck level with engine running at 500 - 600 RPM and add oil to bring level to LOW mark. When oil temperature is hot 180 - 200°F [82.2 - 93.3°C] make final oil level check and adjust if necessary to bring oil level to FULL mark.

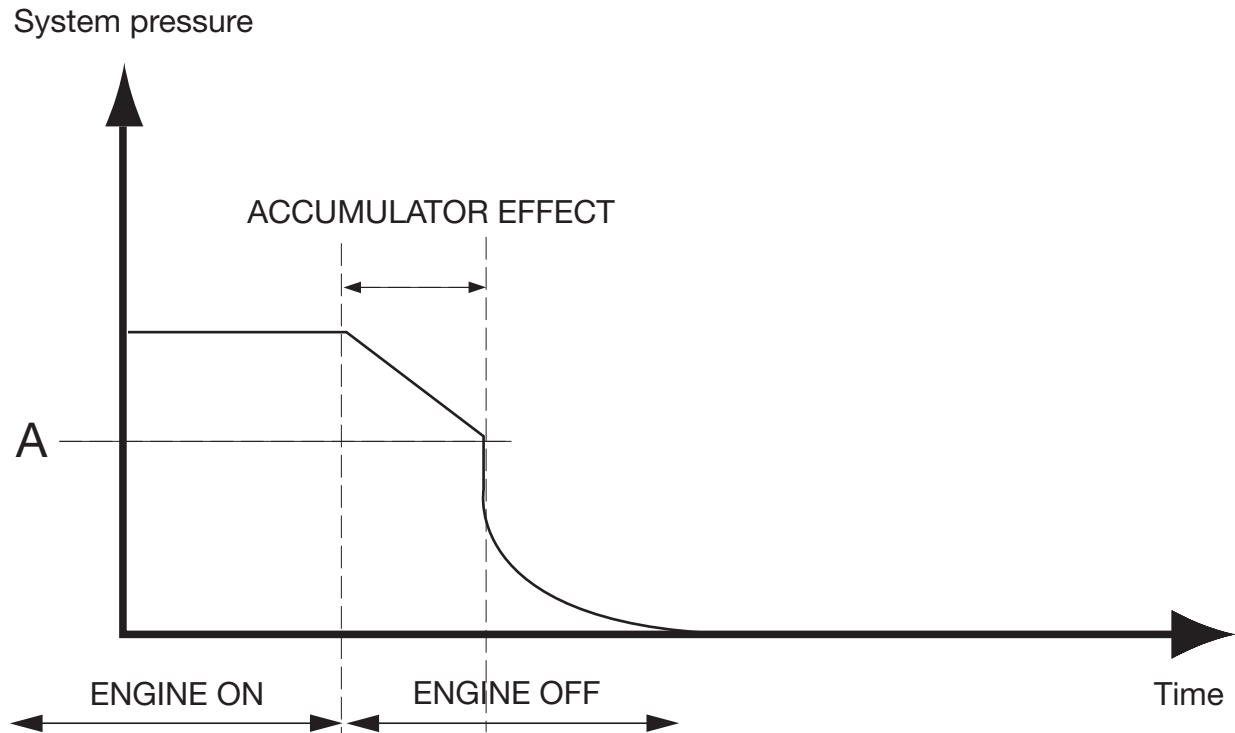
NOTE:

It is recommended that oil filter be changed after 100 hours of operation on new, rebuilt or repaired unit.

MAINTENANCE

ACCUMULATOR CHECK

- 1 - Start the engine when transmission oil is at maximum 86°F [30°C] and wait until system pressure is reached.
- 2 - Turn engine off and keep monitoring system pressure.
- 3 - Check if pressure A is between 10.5 & 14.5 bar*.



Pressure A = pre-charge pressure of accumulator.

* If no pressure port is available, approximate the pre-charge pressure by monitoring the pressure gauge in the vehicle cab during the test.

NOTE:

It is recommended the accumulator is tested after the unit is rebuilt or repaired.

SERVICING MACHINE AFTER COMPONENTS OVERHAUL

The transmission and its hydraulic system are important links in the driveline between the engine and the wheels. The proper operation of either unit depends greatly on the condition and operation of the other. Therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered complete.

After the overhauled or repaired transmission has been installed in the machine, the oil cooler, and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgement must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

- 1 - Drain entire system thoroughly.
- 2 - Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.
- 3 - Replace oil filter element.
- 4 - The oil cooler must be thoroughly cleaned. The cooler should be 'back flushed with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, cooler assembly should be removed from machine for cleaning, using oil, compressed air, and steam cleaner for that purpose.

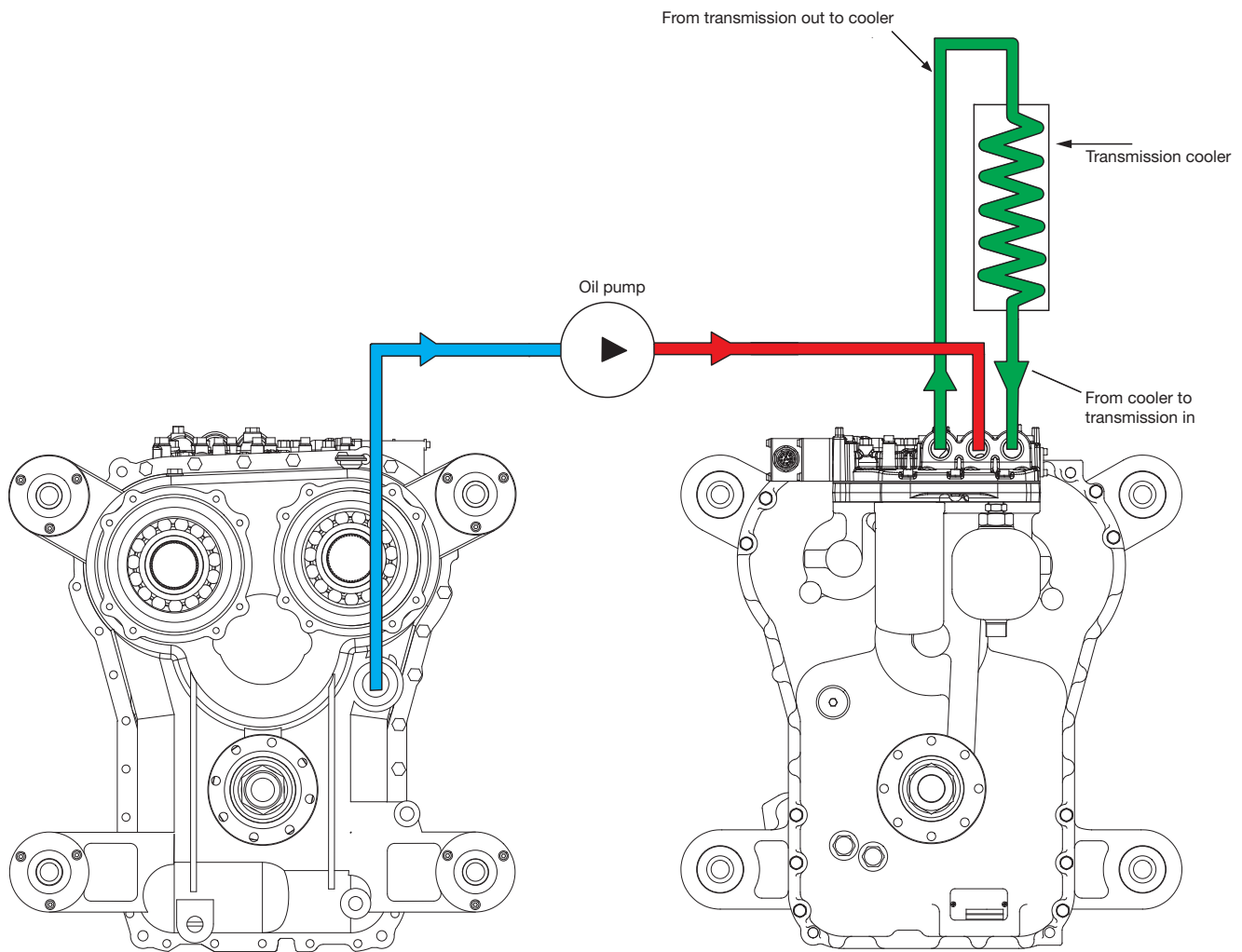
IMPORTANT:

NEVER USE FLUSHING COMPOUNDS FOR CLEANING PURPOSES.

- 5 - Reassemble all components and use only the oil type defined on page 13.
Fill the transmission through filler opening until fluid comes up to FULL mark on transmission.
 - Remove filler plug and fill oil up to the FULL mark.
 - Run engine two minutes at 700 - 800 RPM to prime the hydraulic lines and the oil cooler.
 - Recheck level of fluid in transmission with engine running at idle (700 - 800 RPM).
 - Add quantity necessary to bring fluid level to LOW mark.
 - Recheck with hot oil 180 - 200°F [82.2 - 93.3°C].
 - Adjust oil level to FULL mark.
- 6 - Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

INSTALLATION DETAILS

EXTERNAL PLUMBING



PUMP PRESSURE AND COOLER LINE SPECIFICATIONS

- Minimum 15 mm [.59"] internal diameter for lines and fittings
- Suitable for operation from ambient to 248°F [120°C] continuous operating temperature
- Must withstand 20 bar [290 PSI] continuous pressure and with 40 bar [580 PSI] intermittent surges
- CONFORM SAE J1019 AND SAE J517, 100RI

SUCTION LINE SPECIFICATIONS

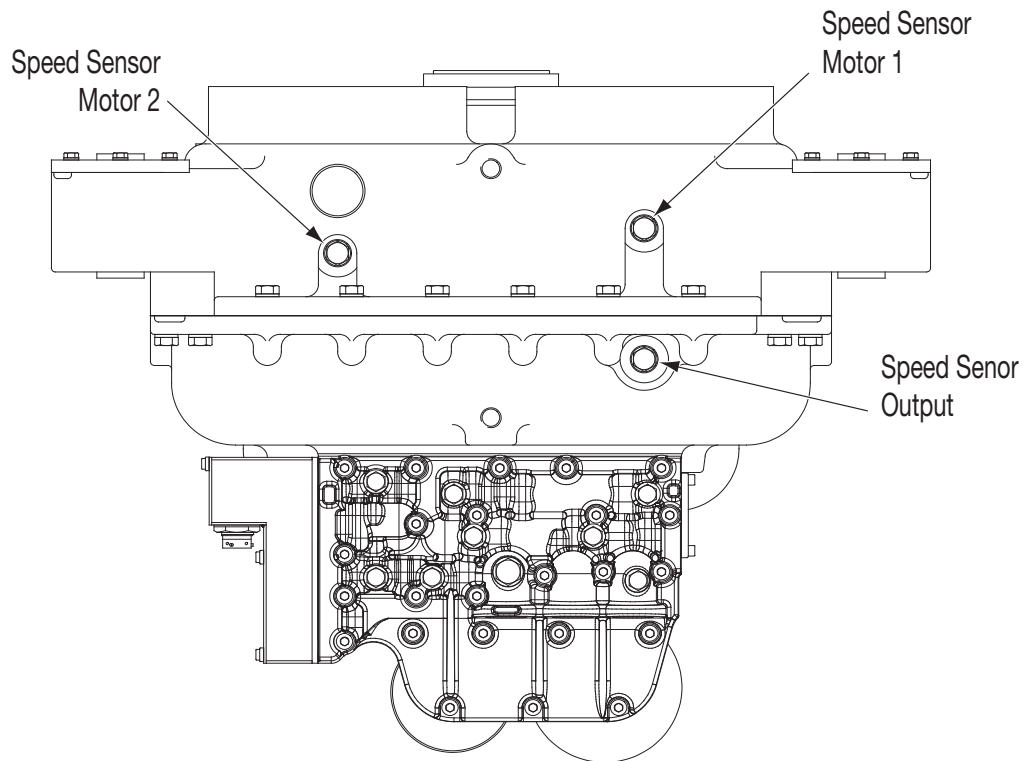
Minimum 32 mm [1.25"] internal diameter for lines and fittings

Suitable for operation from ambient to 248°F [120°C] continuous operating temperature

Must withstand 20 bar [290 PSI] continuous pressure and with 40 bar [580 PSI] intermittent surges

Conform SAE J1019 and SAE J517, 100RI

SPEED SENSOR LOCATION

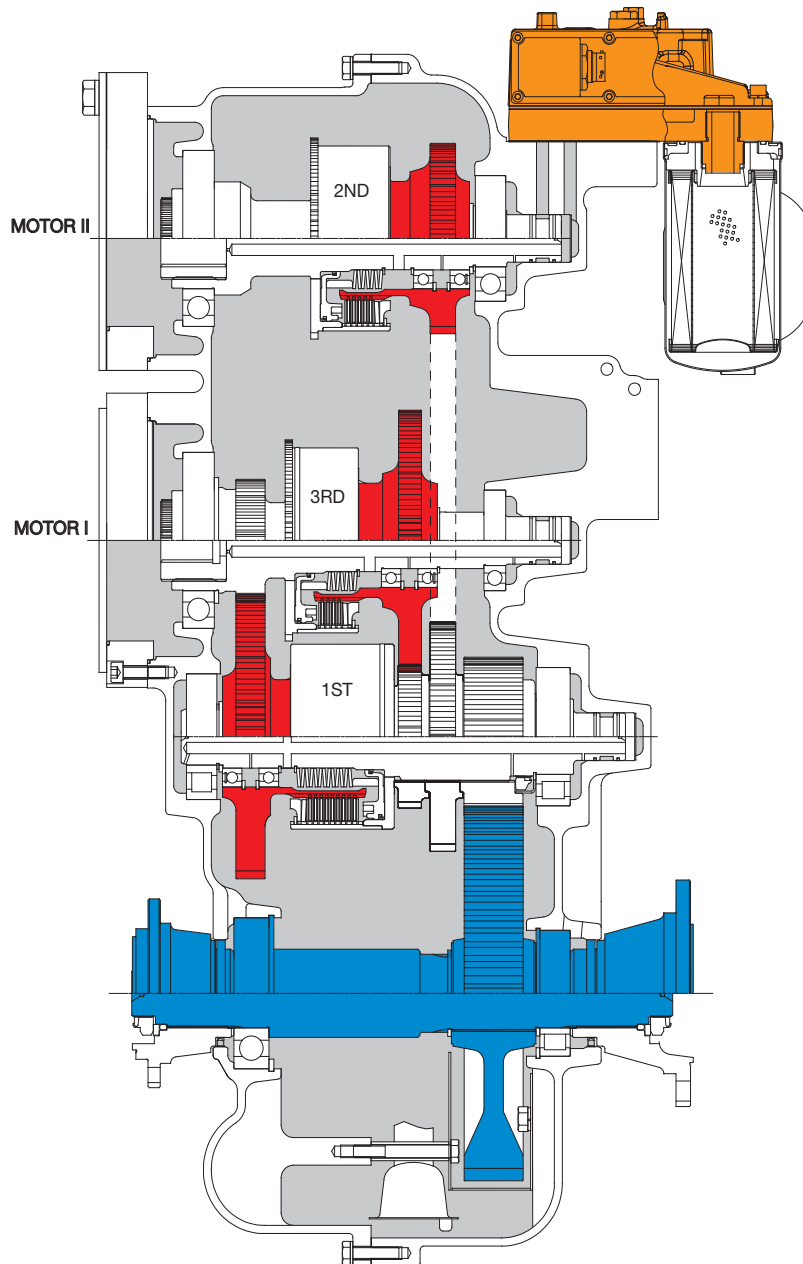


OPERATION OF THE TRANSMISSION

THE TRANSMISSION ASSEMBLY

The transmission is composed of four main assemblies:

- 1 - The transmission charging pump (mounted on the engine)
- 2 - The range clutches
- 3 - The output section
- 4 - The transmission control valve



THE TRANSMISSION CHARGING PUMP

The transmission charging pump is direct-driven by the engine, which is supplying oil to the control valve.

NOTE:

The transmission charging pump is customer mounted and is not supplied by Dana Off-Highway.

OPERATION OF THE TRANSMISSION

THE RANGE CLUTCHES

The range clutches (1st, 2nd & 3rd) consist of a drum with internal splines and a bore to receive a hydraulic actuated piston.

The piston is oil-tight by the use of sealing rings. The steel discs with external splines, and friction discs with internal splines, are alternated until the required total is achieved.

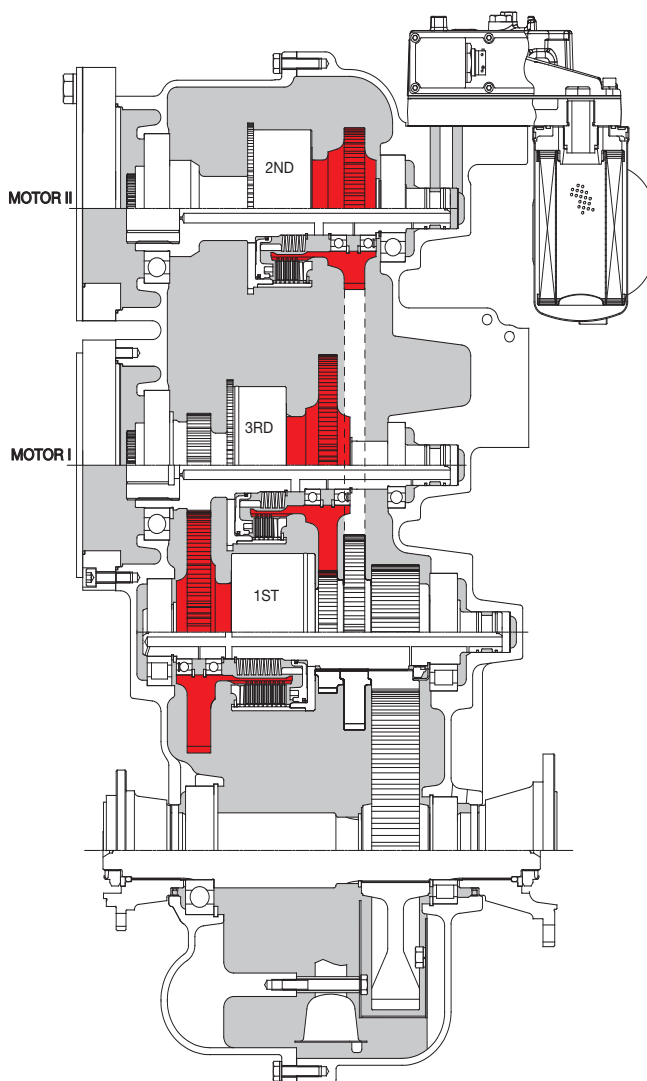
A back-up plate is then inserted and secured with a retainer ring. A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter. The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.

To engage the clutch, a solenoid will direct oil under pressure through tubes and passages to the selected clutch shafts.

Oil sealing rings are located on the clutch shafts. These rings direct the oil through a drilled passage in the shaft to the desired clutch.

Pressure of the oil forces the piston and discs against the back-up plate. The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.

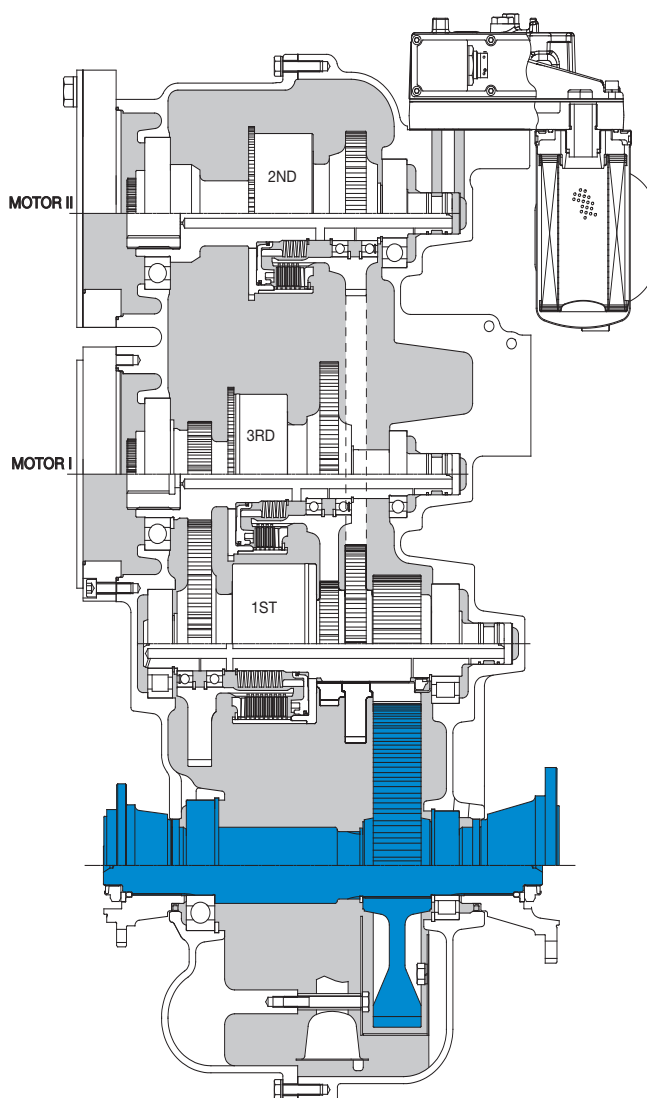
When the clutch is released, a return spring will push the piston back and oil will drain back via the shift spool, or holes in the clutch piston into the transmission sump.



OPERATION OF THE TRANSMISSION

THE OUTPUT SECTION

With a range clutch engaged, power is transmitted from the motor(s) to the output shaft.



OPERATION OF THE TRANSMISSION

THE TRANSMISSION CONTROL VALVE (REFER TO HYDRAULIC DIAGRAM)

The transmission is controlled by the control valve. The control valve assembly is mounted directly on the top of the transmission housing. The function of the control valve assembly is to direct oil under pressure to the desired clutch.

OPERATION OF THE VALVE

The control valve receives oil from the transmission charging pump. In the control valve a pressure regulating valve maintains the oil pressure for actuating the range clutches. This requires a small portion of the total volume of oil, used in the system. The remaining volume of oil is directed through the oil cooler and returns to the transmission for positive lubrication.

The 1st clutch can be closed by activating the 1st solenoid. The 1st solenoid will then allow pilot pressure to move the 1st shift spool. Due to this movement of the 1st shift spool, the 1st clutch will be fed with oil pressure.

When the 2nd solenoid is activated, pilot pressure will move to the 2nd shift spool, and the 2nd clutch will be fed with oil pressure.

When the 3rd solenoid is activated, pilot pressure will move to the 3rd shift spool, and the 3rd clutch will be fed with oil pressure.

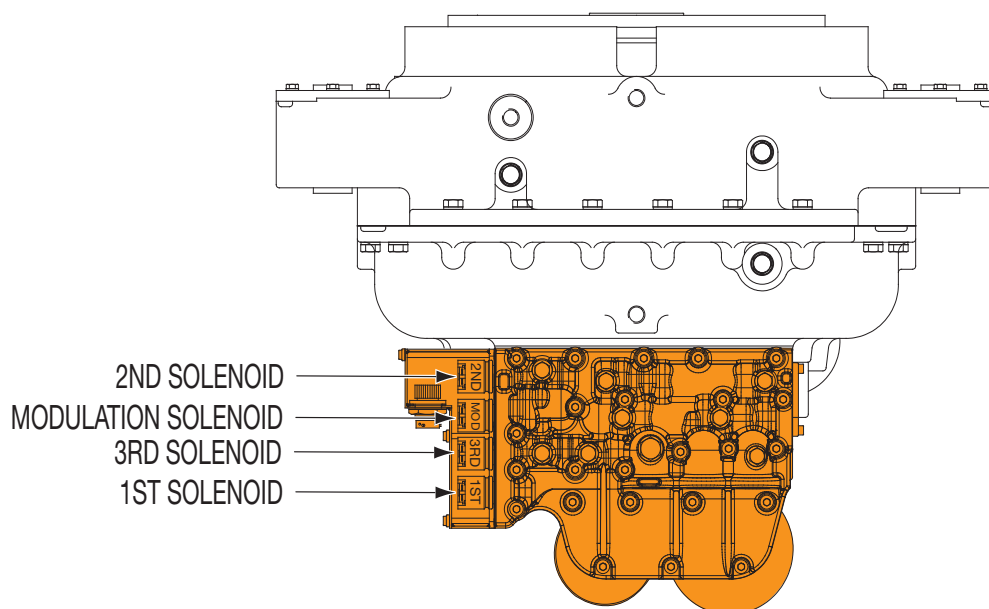
The shift spools of 1st and 3rd are located opposite each other separated by a return spring. This ensures that only 1st or 3rd can be selected.

MODULATION OF THE CLUTCHES

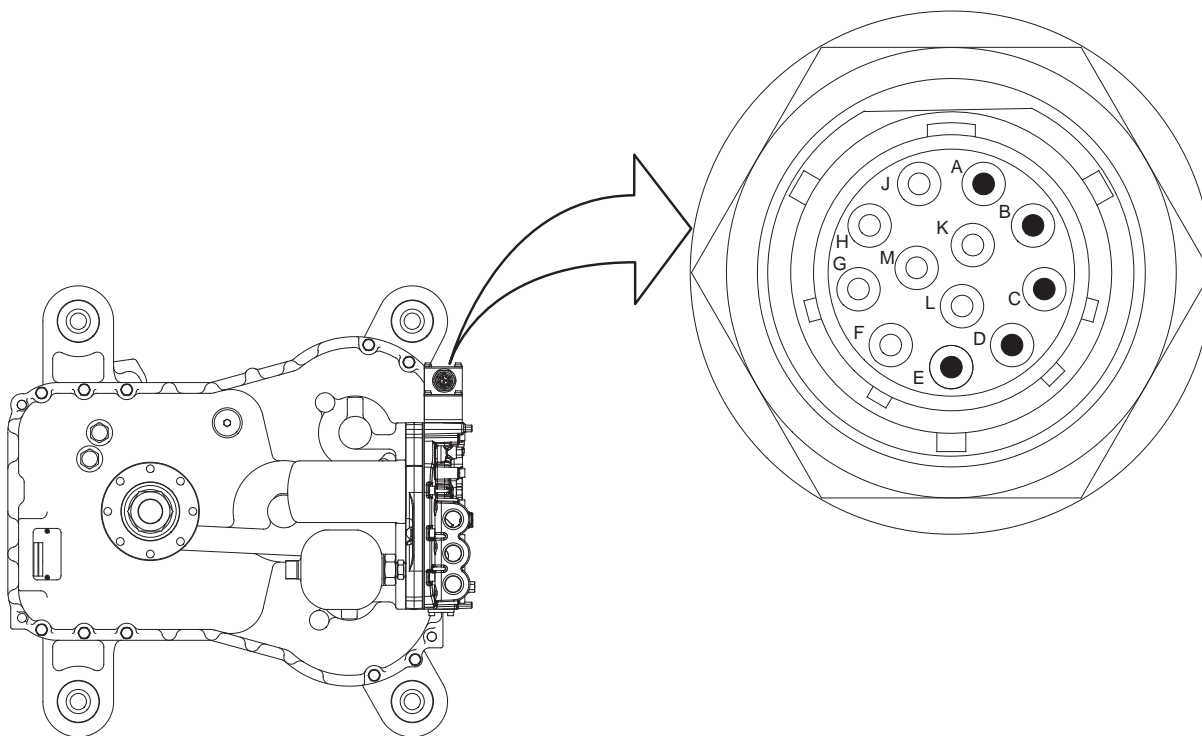
Modulation means, when a clutch is activated, pressure is built up gradually during closing. This results in a smooth engagement of the drive. The modulation is achieved, by activating the modulation solenoid, which results by filling the clutch over a restriction. Once the clutch is closed, the modulation solenoid is switched-off, and the clutch receives the full pressure.

ELECTRONIC SOLENOID CONTROLS

Transmission Gear	Activated Solenoids	Activated Clutches
1	1st, 2nd	1st
2	2nd	2nd
3	3rd	3rd



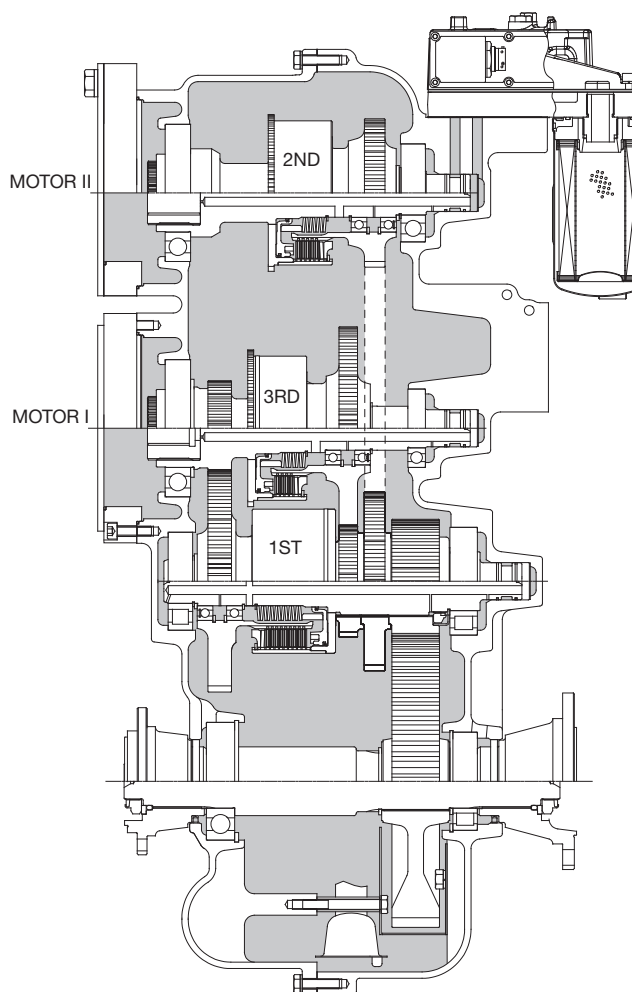
OPERATION OF THE TRANSMISSION



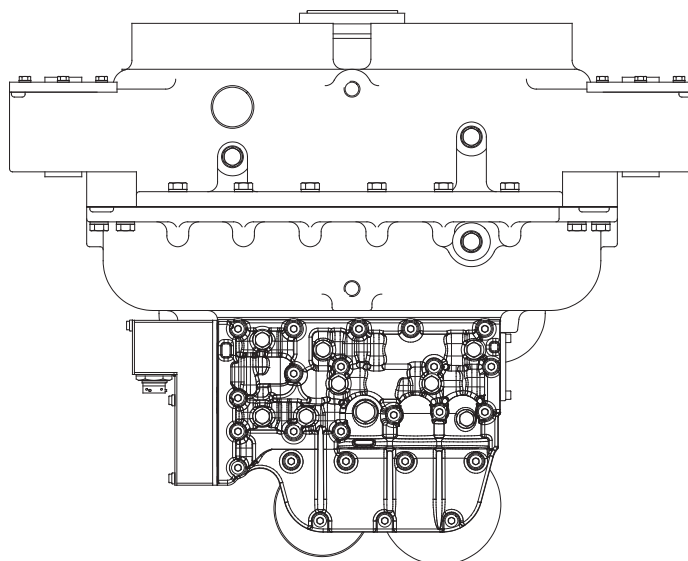
Connecting pin	Wire color	Function
A	Red	Modulation solenoid
B	Green	2nd solenoid
C	Blue	3rd solenoid
D	Yellow	1st solenoid
E	White	Common ground

POWER FLOWS, SOLENOIDS, & HYDRAULIC CIRCUITS

NEUTRAL

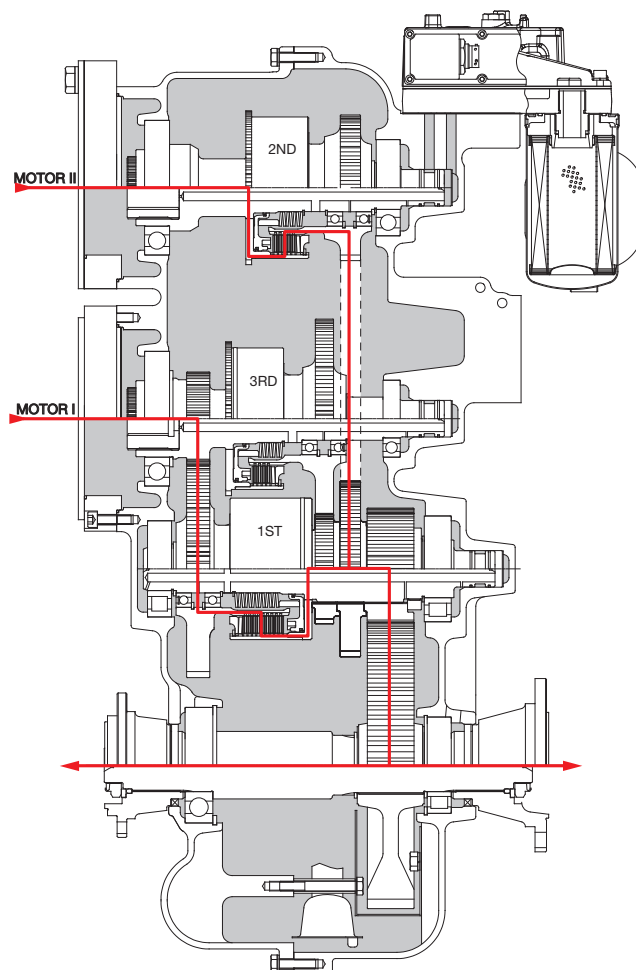


NEUTRAL (ACTIVATED SOLENOIDS)

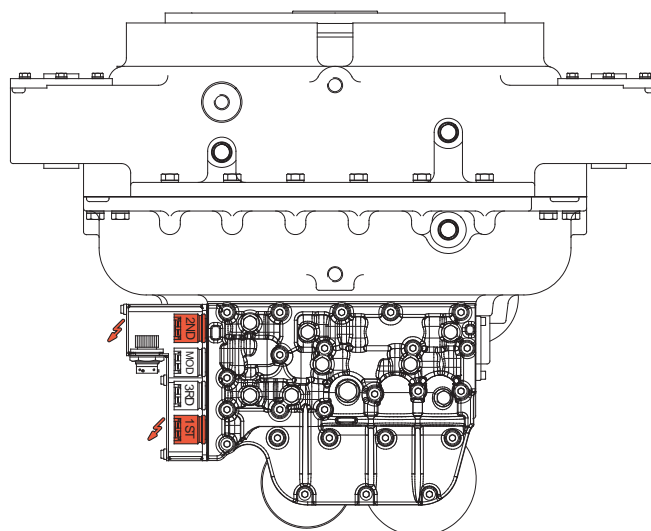


POWER FLOWS, SOLENOIDS, & HYDRAULIC CIRCUITS

1ST GEAR

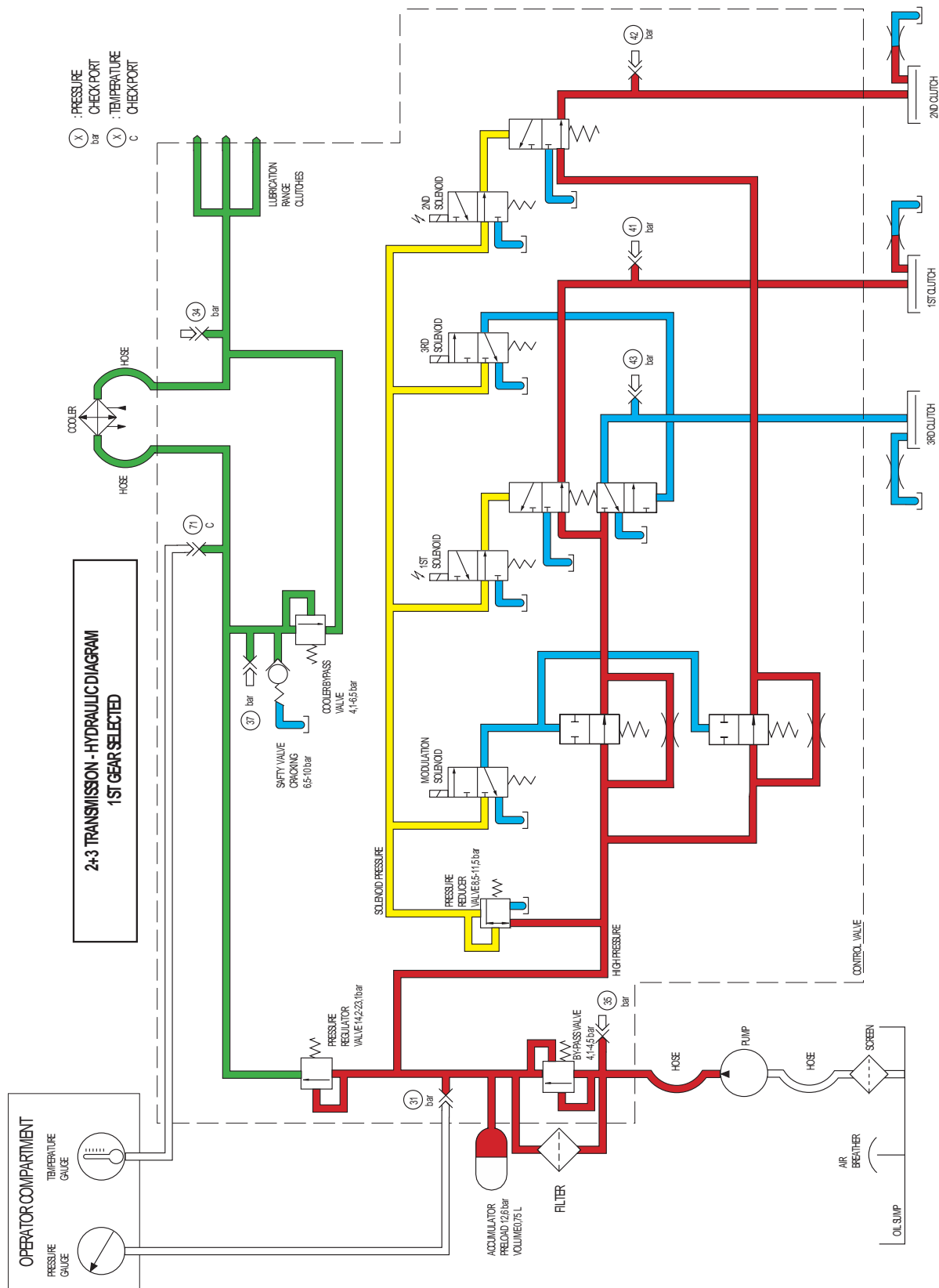


1ST GEAR (ACTIVATED SOLENOIDS)

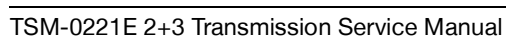


POWER FLOWS, SOLENOIDS, & HYDRAULIC CIRCUITS

1ST GEAR (CONTINUED)

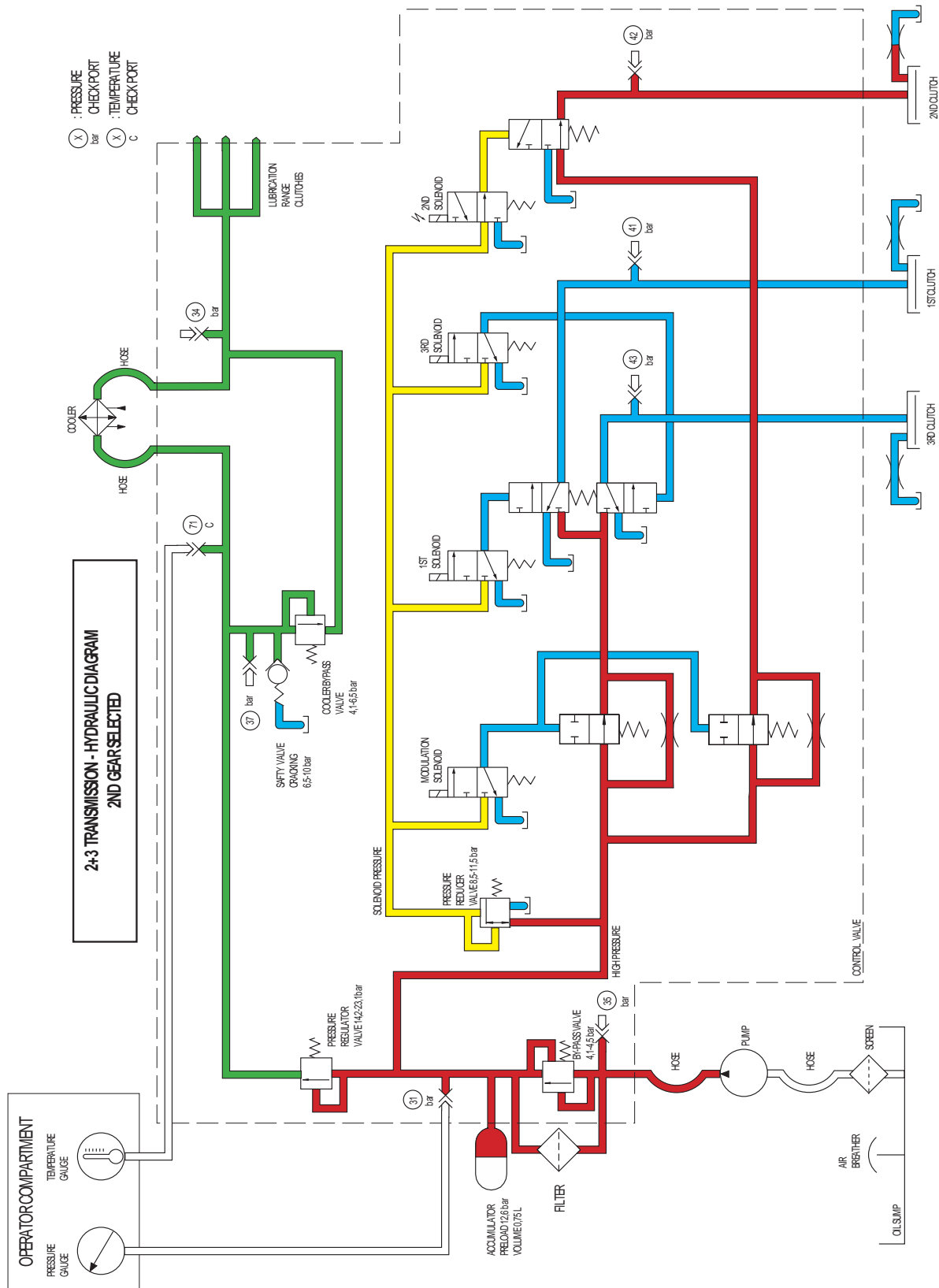


2ND GEAR



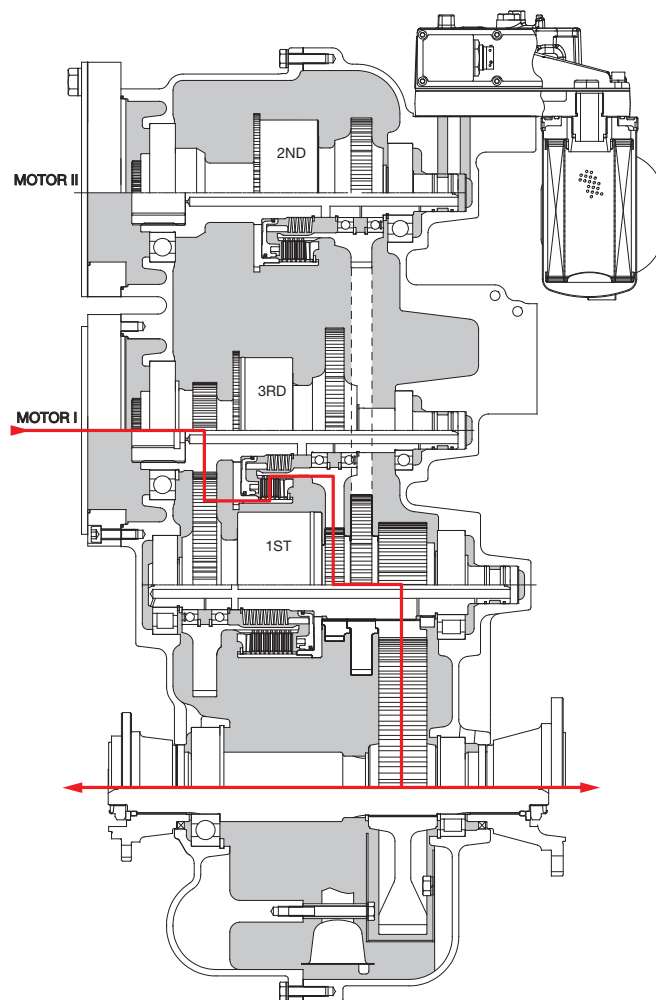
POWER FLOWS, SOLENOIDS, & HYDRAULIC CIRCUITS

2ND GEAR (CONTINUED)

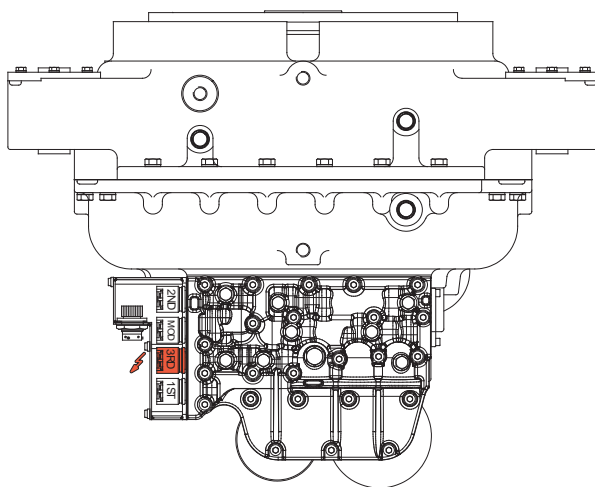


POWER FLOWS, SOLENOIDS, & HYDRAULIC CIRCUITS

3RD GEAR

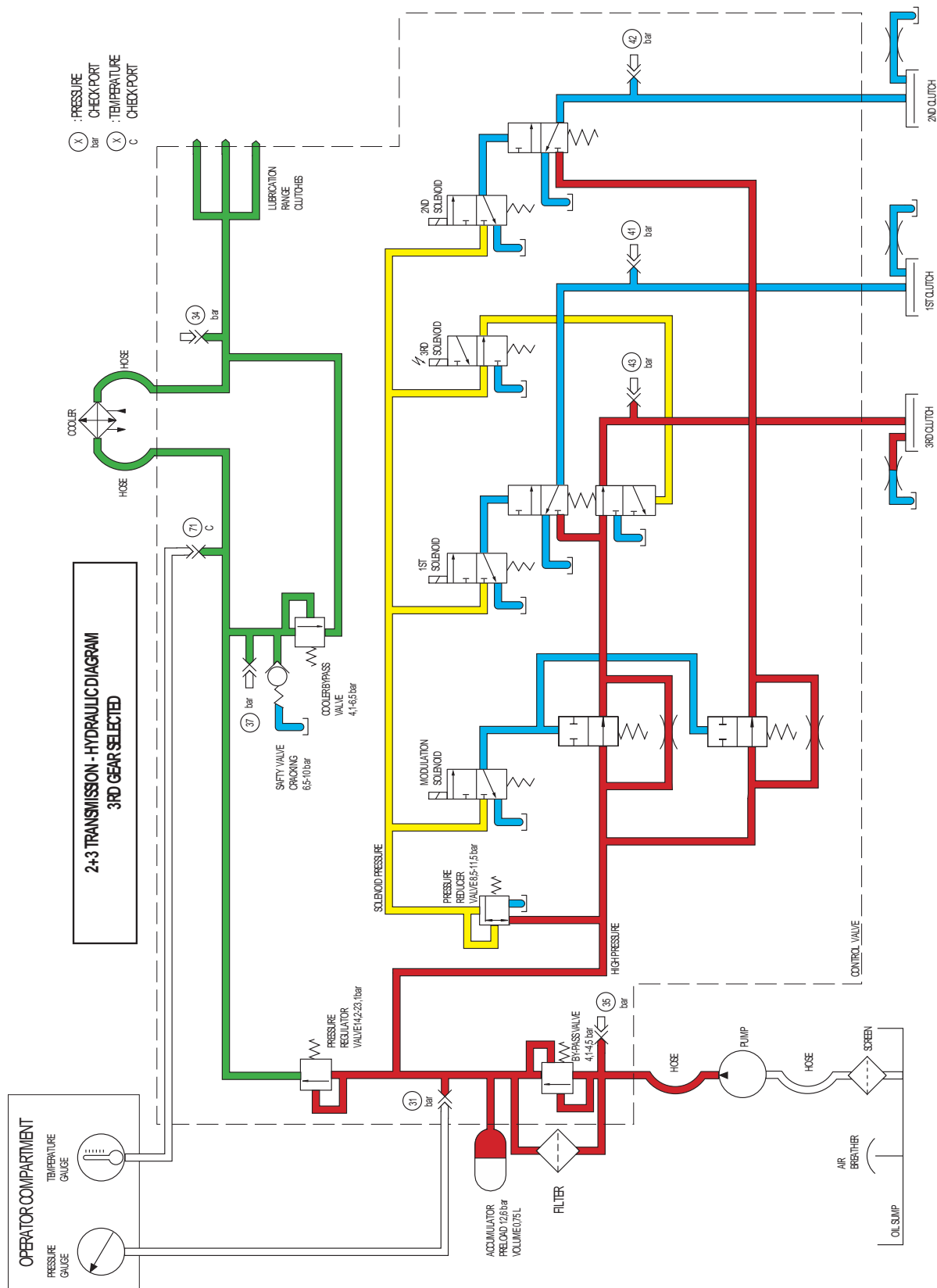


3RD GEAR (ACTIVATED SOLENOIDS)

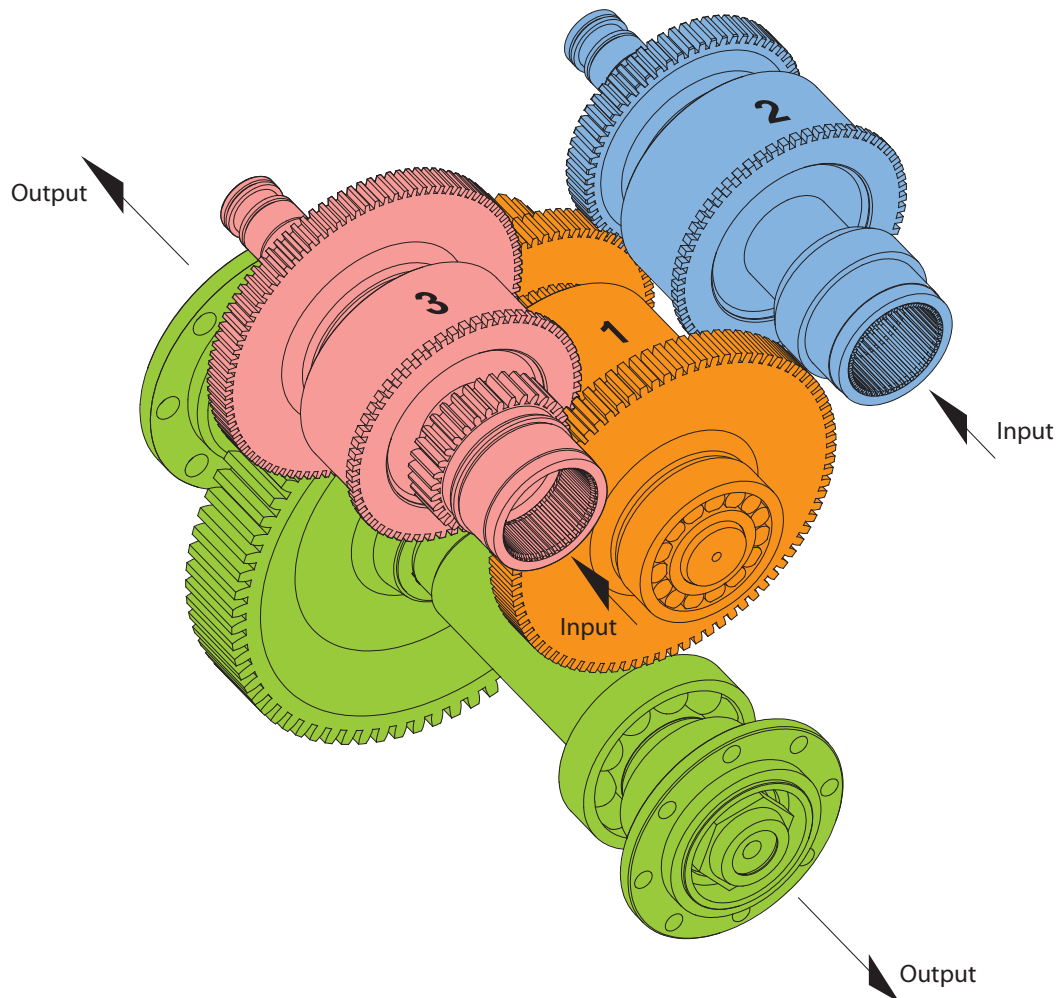


POWER FLOWS, SOLENOIDS, & HYDRAULIC CIRCUITS

3RD GEAR (CONTINUED)



GEAR AND CLUTCH LAYOUT



TROUBLESHOOTING

The following information is presented as an aid to isolating and determining the specific problem area in a transmission that is not functioning correctly.

When troubleshooting a transmission problem, it should be kept in mind that the transmission is only the central unit of a group of related powertrain components. Proper operation of the transmission depends on the condition and correct functioning of the other components of the group. Therefore, to properly diagnose a suspected problem in the transmission, it is necessary to consider the transmission fluid, charging pump, transmission assembly, oil cooler, filter, connecting lines, and controls, including the engine, as a complete system.

By analyzing the principles of operation together with the information in this section, it should be possible to identify and correct any malfunction which may occur in the system.

The 2+3 transmission troubles fall into three general categories:

1 - Mechanical problems

2 - Hydraulic problems.

3 - Electrical problems.

In addition to the mechanical and electrical components, all of which must be in the proper condition and functioning correctly, the correct functioning of the hydraulic circuit is most important. Transmission fluid is the "life blood" of the transmission. It must be supplied in an adequate quantity and delivered to the system at the correct pressures to engage and hold the clutches from slipping, and to cool and lubricate the working components.

TROUBLESHOOTING PROCEDURE

TRANSMISSION PRESSURE CHECKS

Transmission problems can be isolated by the use of pressure tests. In addition, charging pressure and transmission lubrication pressure can also be measured.

MECHANICAL AND ELECTRICAL CHECKS

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure all components of the cooling system are in good condition and operating correctly. The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.

HYDRAULIC CHECKS

Also, before checking the transmission clutches, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid checks:

- Check oil level in the transmission. The transmission fluid must be at the correct (full level).
- All clutches and its fluid circuit lines must be fully charged (filled) at all times.

NOTE:

THE TRANSMISSION FLUID MUST BE AT OPERATING TEMPERATURE OF 180 - 200°F [82 - 93°C] TO OBTAIN CORRECT FLUID LEVEL AND PRESSURE READINGS. NEVER MAKE THESE CHECKS WITH COLD OIL.

Transmission problems can be isolated by the use of pressure tests. In addition, charging pressure and transmission lubrication pressure can also be measured.

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure that all components of the cooling system are in good condition and operating correctly. The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.

Also, before checking the transmission clutches, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:

Check oil level in the transmission. The transmission fluid must be at the correct (full level).

All clutches and its fluid circuit lines must be fully charged (filled) at all times.

NOTE:

THE TRANSMISSION FLUID MUST BE AT OPERATING TEMPERATURE OF 180 - 200°F [82 - 93°C] TO OBTAIN CORRECT FLUID LEVEL AND PRESSURE READINGS. NEVER MAKE THESE CHECKS WITH COLD OIL.

TROUBLESHOOTING PROCEDURE

TROUBLESHOOTING PROCEDURE

Refer to the following troubleshooting guide for the diagnosis of typical transmission troubles.

TRANSMISSION PRESSURE CHECKS

LOW CLUTCH PRESSURE

CAUSE	REMEDY
Low oil level	Fill to proper level
Clutch pressure regulating valve stuck open	Replace control valve
Faulty charging pump	Replace pump
Broken or worn clutch shaft piston sealing rings	Replace sealing rings

LOW CHARGING PUMP OUTPUT

CAUSE	REMEDY
Low oil level	Fill to proper level
Defective charging pump	Replace pump

OVERHEATING

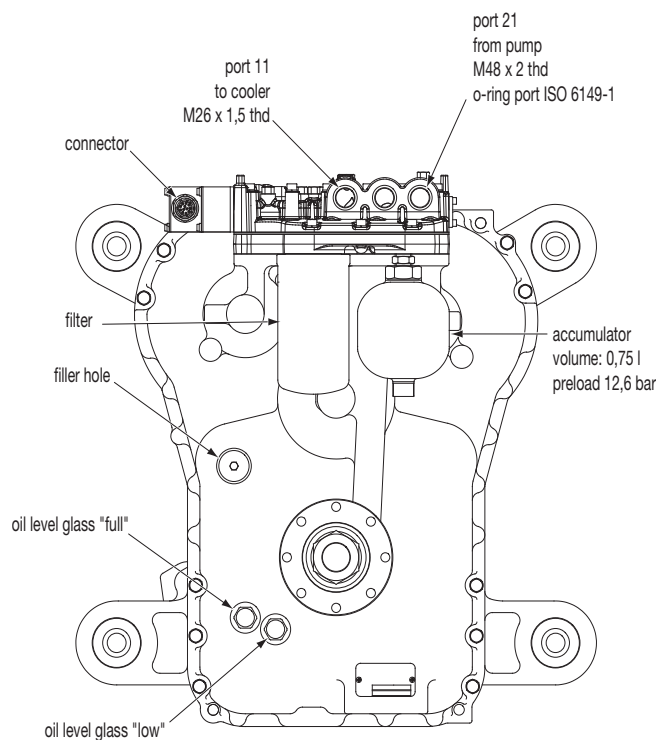
CAUSE	REMEDY
Worn charging pump	Replace charging pump
Low oil level	Fill to proper level
Dirty oil cooler	Clean cooler
Restriction in cooler lines	Change cooler lines

2ND SLIPPING CLUTCH

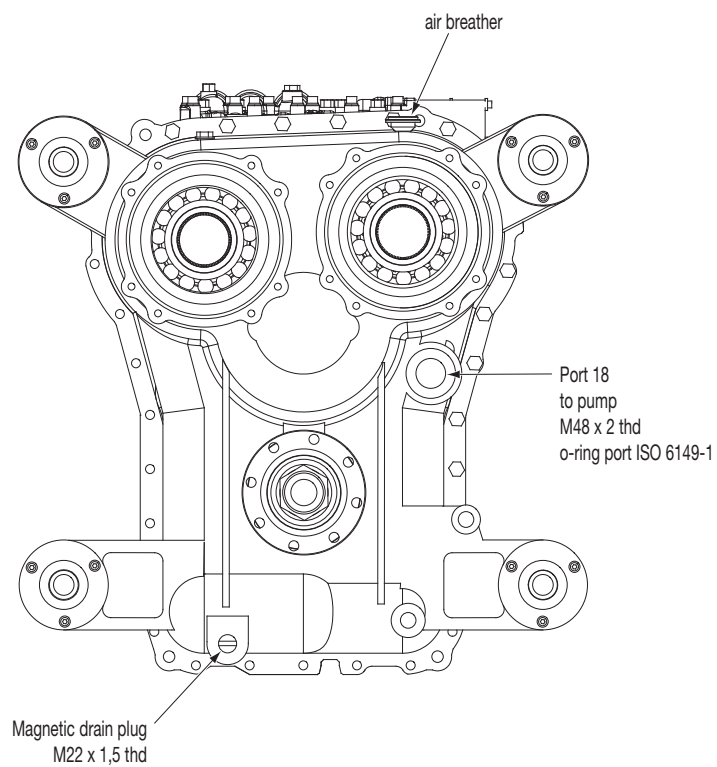
CAUSE	REMEDY
2nd clutch is slipping during shifting	Check accumulator

CHECK POINTS

REAR VIEW

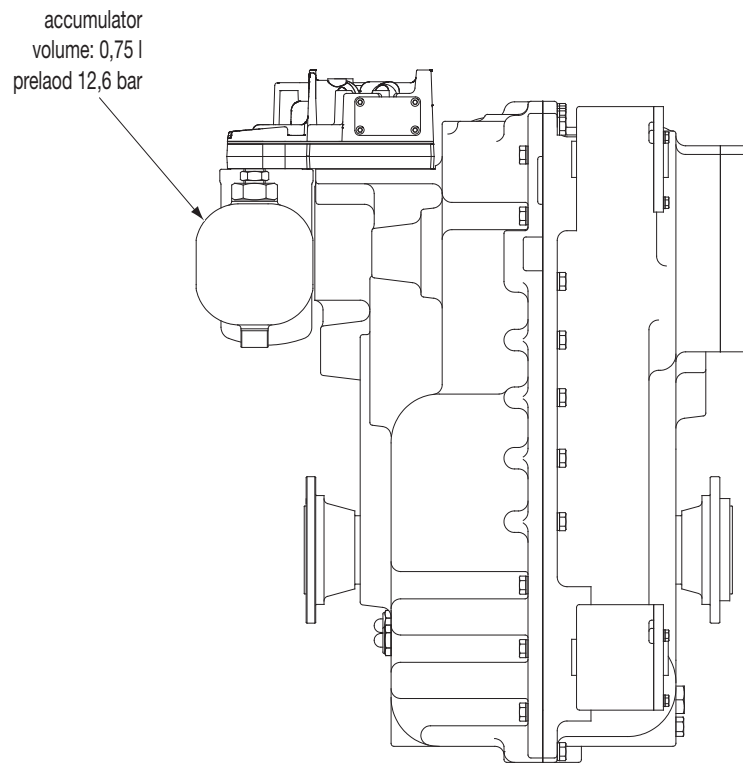


FRONT VIEW

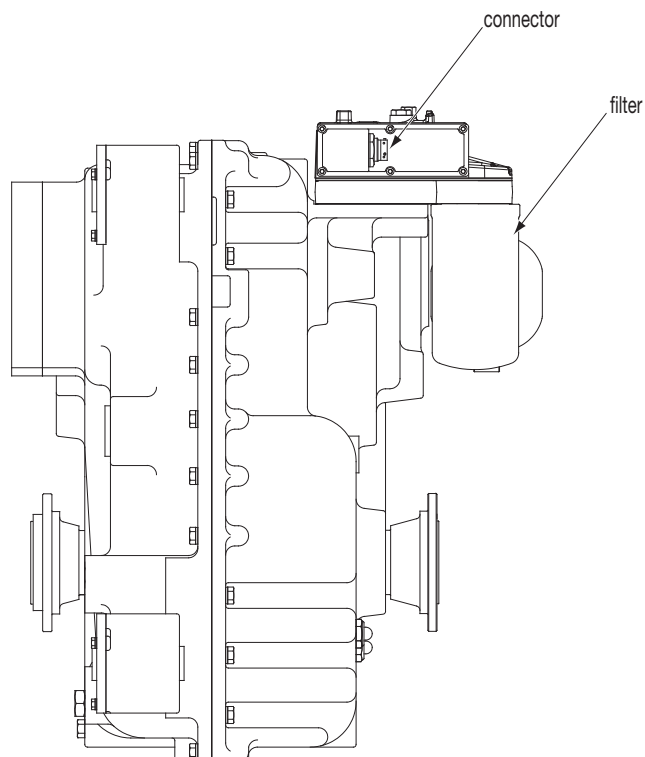


CHECK POINTS

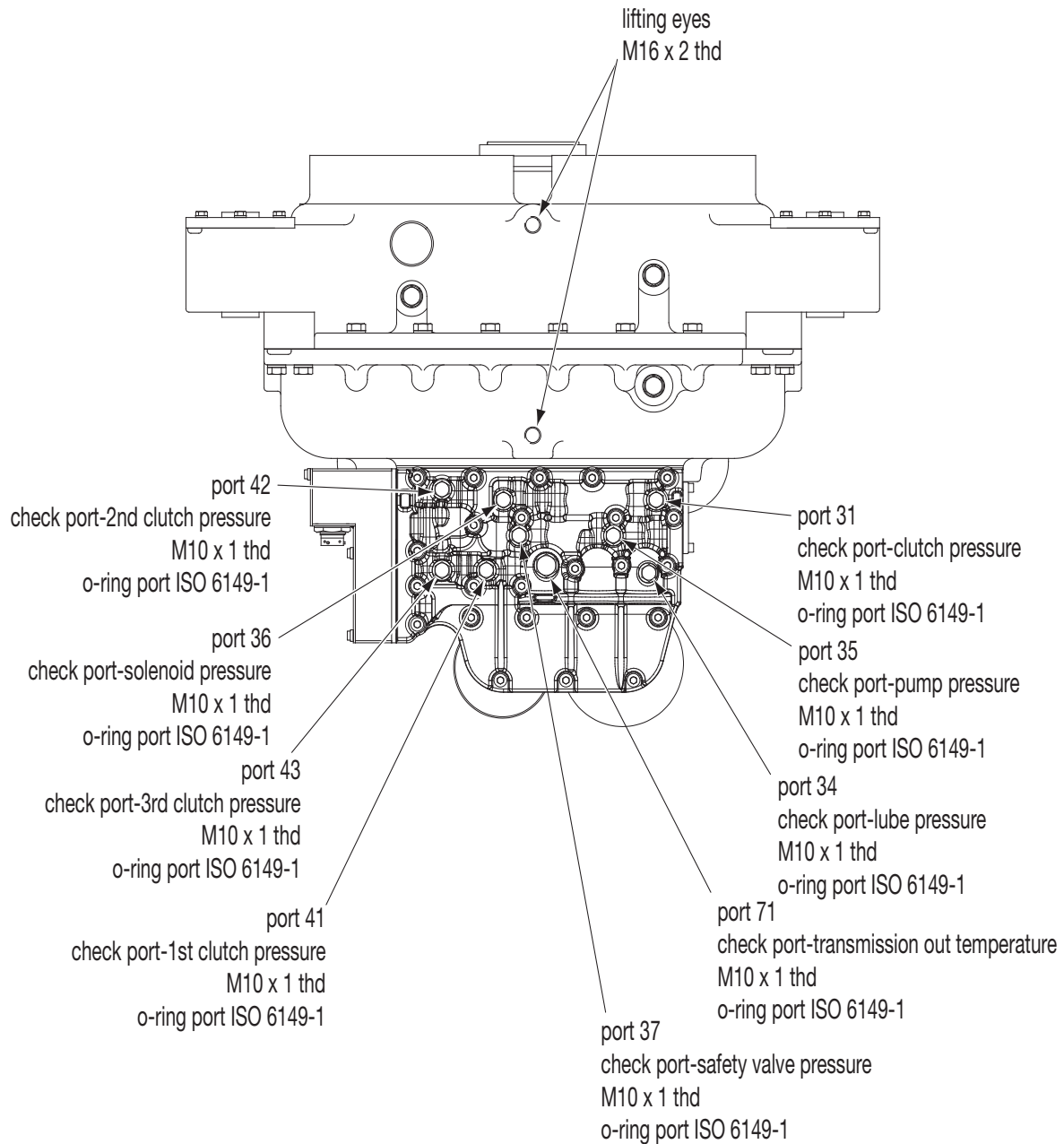
RIGHT VIEW



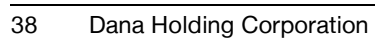
LEFT VIEW



TOP VIEW



GROUP - HYDROSTATIC OIL PUMP CASE

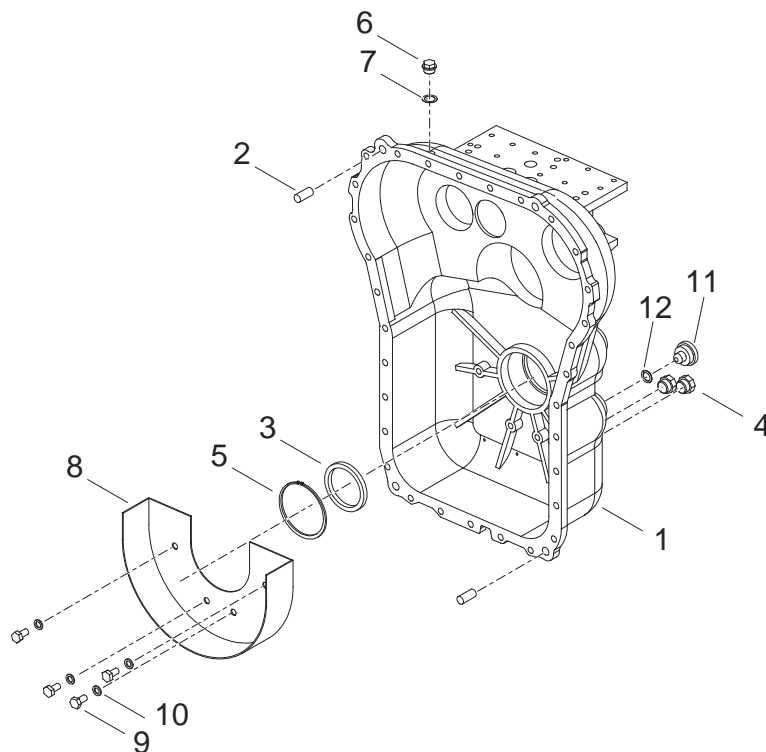


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Case - Hydrostatic motors	1
2	Gasket - Case to hydrostatic case	1
3	Screw - Case to hydrostatic case	31
4	Lock washer - Case to hydrostatic case screw	31
5	Seal - Output shaft front oil	1
6	Plate - Baffle oil	1
7	Screw - Oil baffle plate mounting	4
8	Spacer - Oil baffle plate	4
9	Plug - Speed sensor port	2
10	O-ring - Speed sensor port plug	2
11	Assembly - Suction tube	1
12	Screw - Suction tube mounting	2
13	Lock washer - Suction tube mounting screw	2
14	O-ring - Suction tube	1
15	Snap ring - Output shaft front bearing	1
16	Plug - Magnetic drain	1
17	Air - breather	1
18	Screw - Silent block lock plate	12
19	Lock washer - Silent block lock plate screw	12
20	Plate - Silent block	4
21	Block Silent	4
22	O-ring - Protection cover	2
23	Cover - Protection	2
24	Screw - Protection cover	8
25	Lock washer - Protection cover screw	8

SECTIONAL VIEWS AND PARTS IDENTIFICATION

GROUP - TRANSMISSION CASE

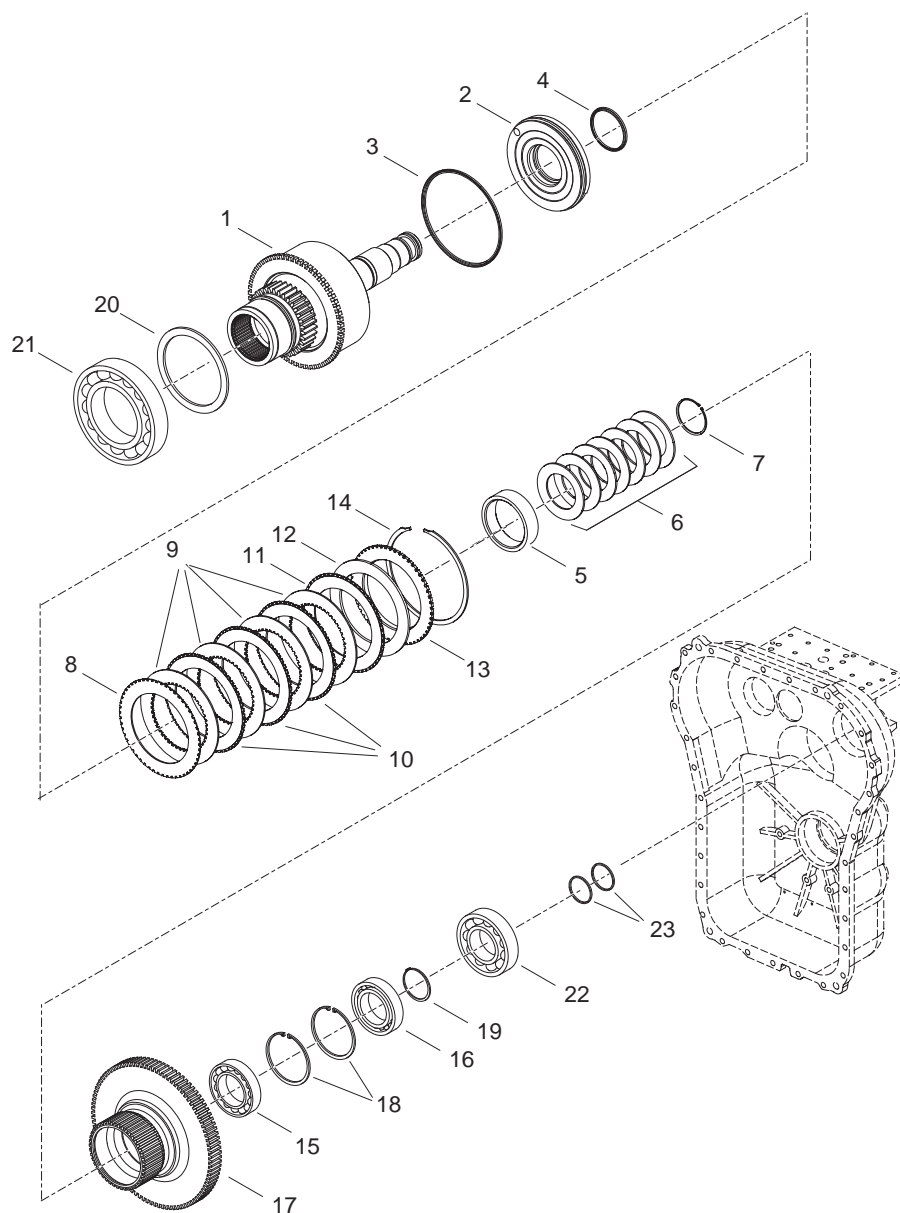


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Case - Transmission	1
2	Pin - Dowel	2
3	Seal - Output shaft rear oil	1
4	Glass - Oil level	2
5	Snap ring - Output shaft rear bearing	1
6	Plug - Speed sensor port	1
7	O-ring - Speed sensor port plug	1
8	Baffle - Oil	1
9	Screw - Oil baffle mounting	4
10	Lock washer - Oil baffle mounting screw	4
11	Plug - Filler	1
12	O-ring - Filler plug	1

SECTIONAL VIEWS AND PARTS IDENTIFICATION

GROUP - 3RD SHAFT AND GEAR MOTOR 1

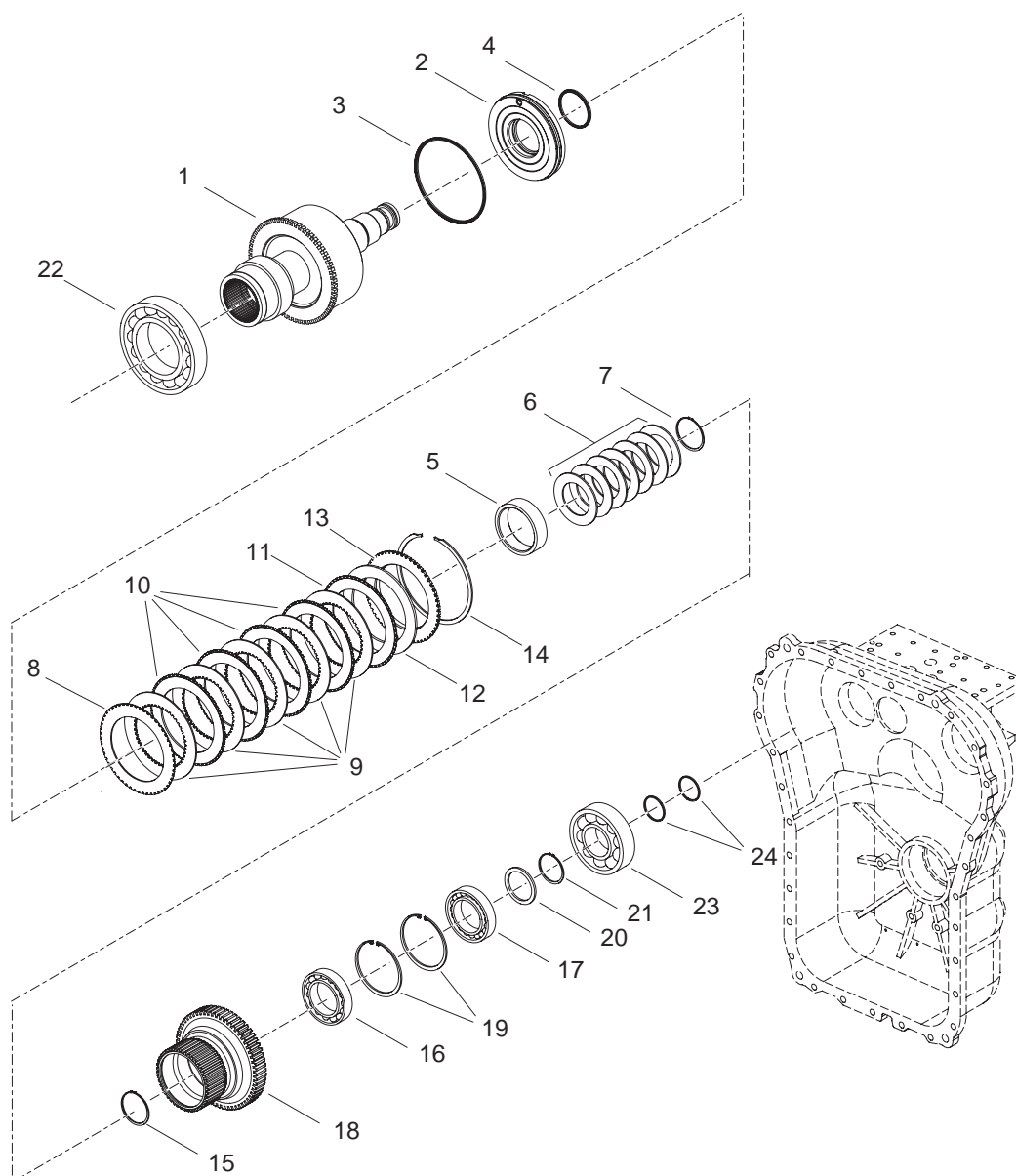


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Assembly - 3rd shaft, hub, drum and plug	1
2	Piston - Clutch	1
3	Seal - Clutch piston outer	1
4	Seal - Clutch piston inner	1
5	Sleeve - Clutch piston wear	1
6	Assembly - Disc spring	1
7	Retaining ring - Spring	1
8	Disc - Outer half	1
9	Disc - Inner	4
10	Disc - Outer	3
11	Disc - Outer half	1
12	Spring disc - Modulation	1
13	Plate - End	1
14	Snap ring - End plate	1
15	Bearing - Clutch gear inner	1
16	Bearing - Clutch gear outer	1
17	Gear - 3rd clutch	1
18	Snap ring - Clutch gear bearing	2
19	Retaining ring - Clutch gear outer bearing	1
20	Spacer - 3rd shaft front bearing	1
21	Bearing - 3rd shaft front	1
22	Bearing - 3rd shaft gear	1
23	Piston ring - 3rd shaft	2

SECTIONAL VIEWS AND PARTS IDENTIFICATION

GROUP - 3RD SHAFT AND GEAR MOTOR 2

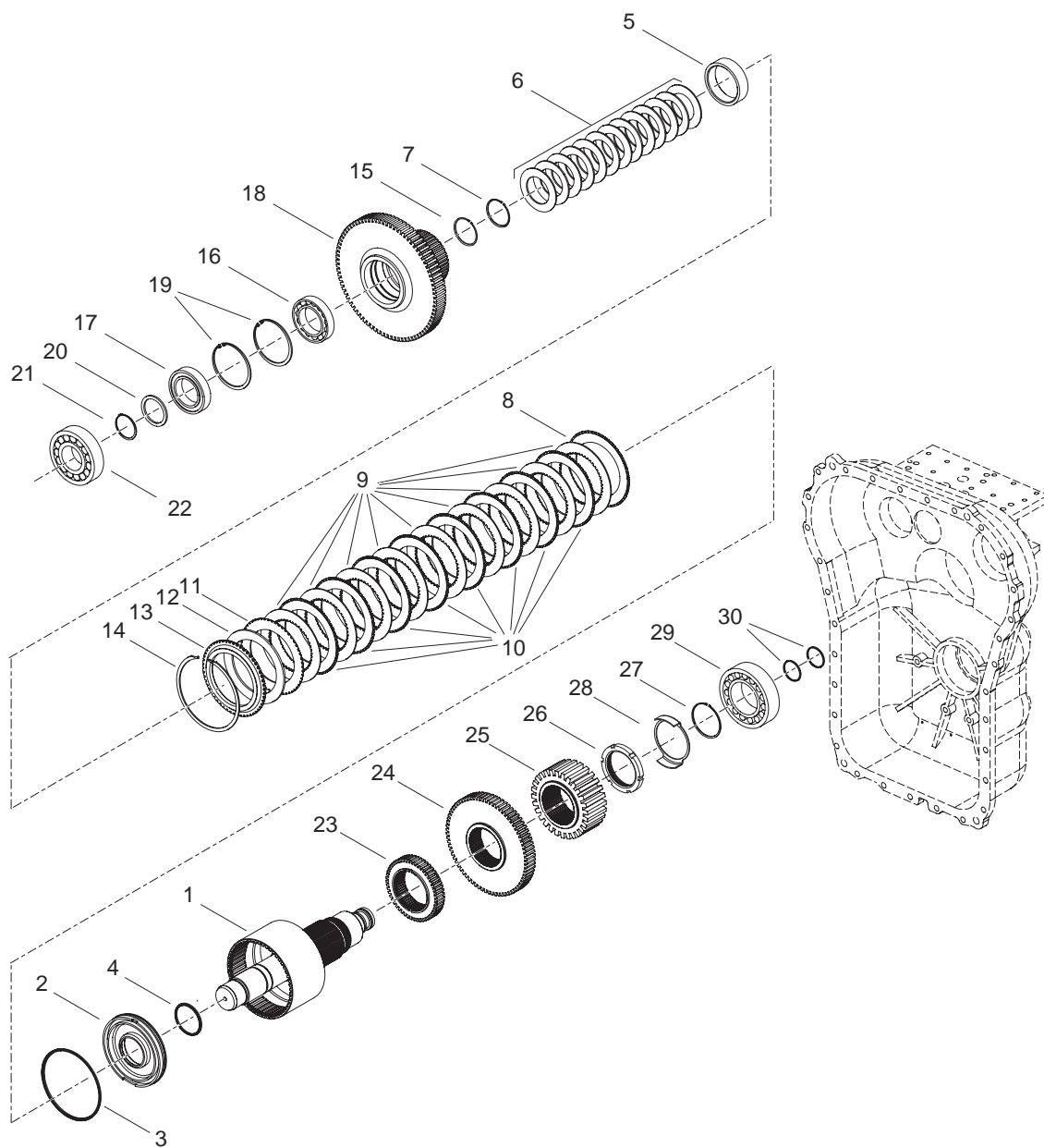


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Assembly - 2nd shaft, hub, drum and plug	1
2	Piston - Clutch	1
3	Seal - Clutch piston outer	1
4	Seal - Clutch piston inner	1
5	Sleeve - Clutch piston wear	1
6	Assembly - Disc spring	1
7	Retaining ring - Spring	1
8	Disc - Outer half	1
9	Disc - Inner	4
10	Disc - Outer	3
11	Disc - Outer half	1
12	Spring disc - Modulation	1
13	Plate - End	1
14	Snap ring - End plate	1
15	Snap ring - Inner bearing	1
16	Bearing - Clutch gear inner	1
17	Bearing - Clutch gear outer	1
18	Gear - 2nd clutch	1
19	Snap ring - Clutch gear bearing	2
20	Spacer - Clutch gear outer bearing	1
21	Retaining ring - Clutch gear outer bearing	1
22	Bearing- 2nd shaft front	1
23	Bearing - 2nd shaft rear	1
24	Piston ring - 2nd shaft	2

SECTIONAL VIEWS AND PARTS IDENTIFICATION

GROUP - 1ST SHAFT AND GEARS

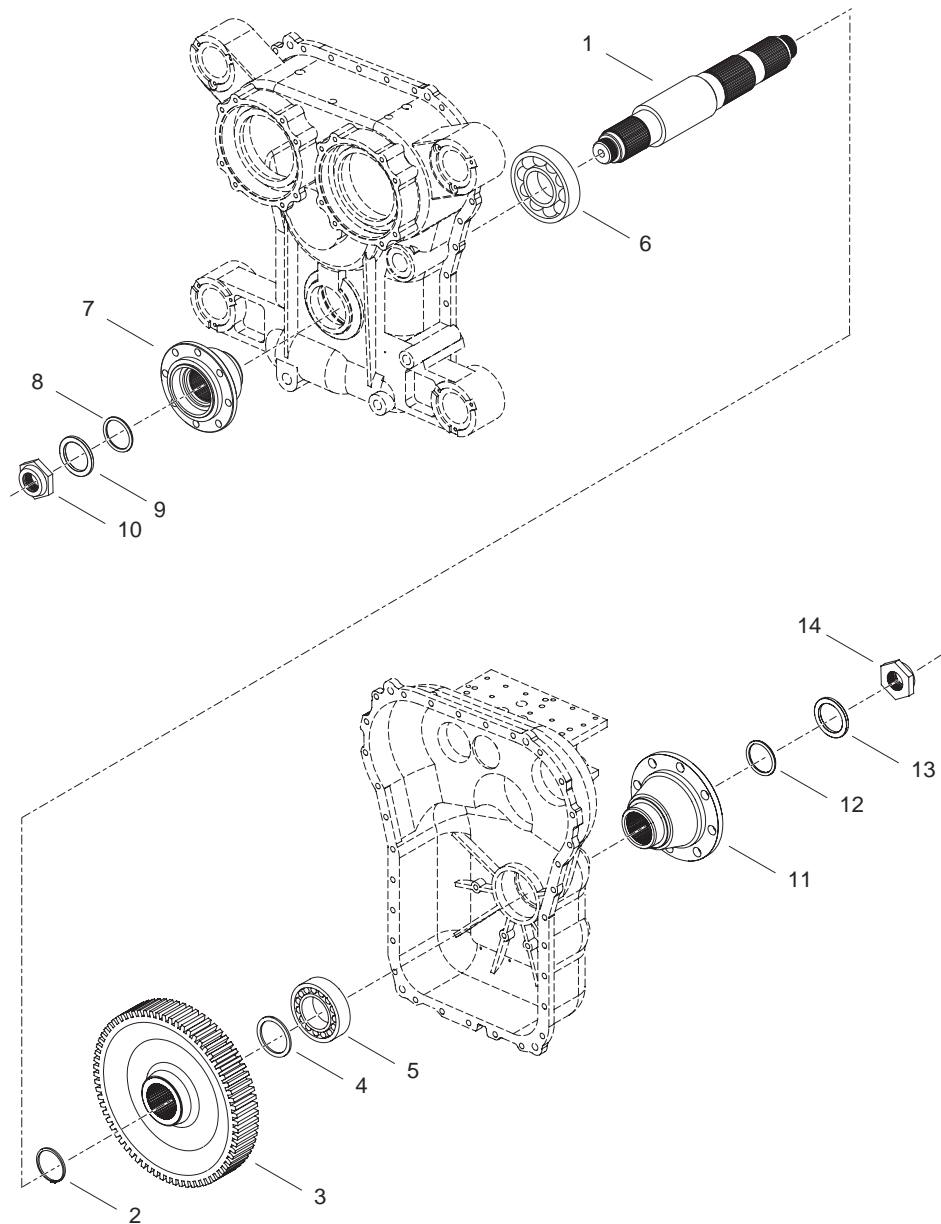


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Assembly - 1st shaft, hub, drum and plug	1
2	Piston - Clutch	1
3	Seal - Clutch piston outer	1
4	Seal - Clutch piston inner	1
5	Sleeve - Clutch piston wear	1
6	Assembly - Disc spring	1
7	Retaining ring- spring	1
8	Disc - Outer half	1
9	Disc - Inner	9
10	Disc - Outer	8
11	Disc - Outer half	1
12	Spring disc - Modulation	1
13	Plate - End	1
14	Snap ring - End plate	1
15	Snap ring - Inner bearing	1
16	Bearing - Clutch gear inner	1
17	Bearing - Clutch gear outer	1
18	Gear - 1st clutch	1
19	Snap ring - Clutch gear bearing	2
20	Washer - Clutch gear outer bearing	1
21	Retaining ring - Clutch gear outer bearing	1
22	Bearing - 1st shaft front	1
23	Gear - 3rd driven	1
24	Gear - 2nd driven	1
25	Gear - Output drive	1
26	Nut - Gear retaining	1
27	Snap ring - 1st shaft rear bearing	1
28	Retainer - Snap ring	1
29	Bearing - 1st shaft rear	1
30	Piston ring - 1st shaft	1

SECTIONAL VIEWS AND PARTS IDENTIFICATION

GROUP - OUTPUT SHAFT

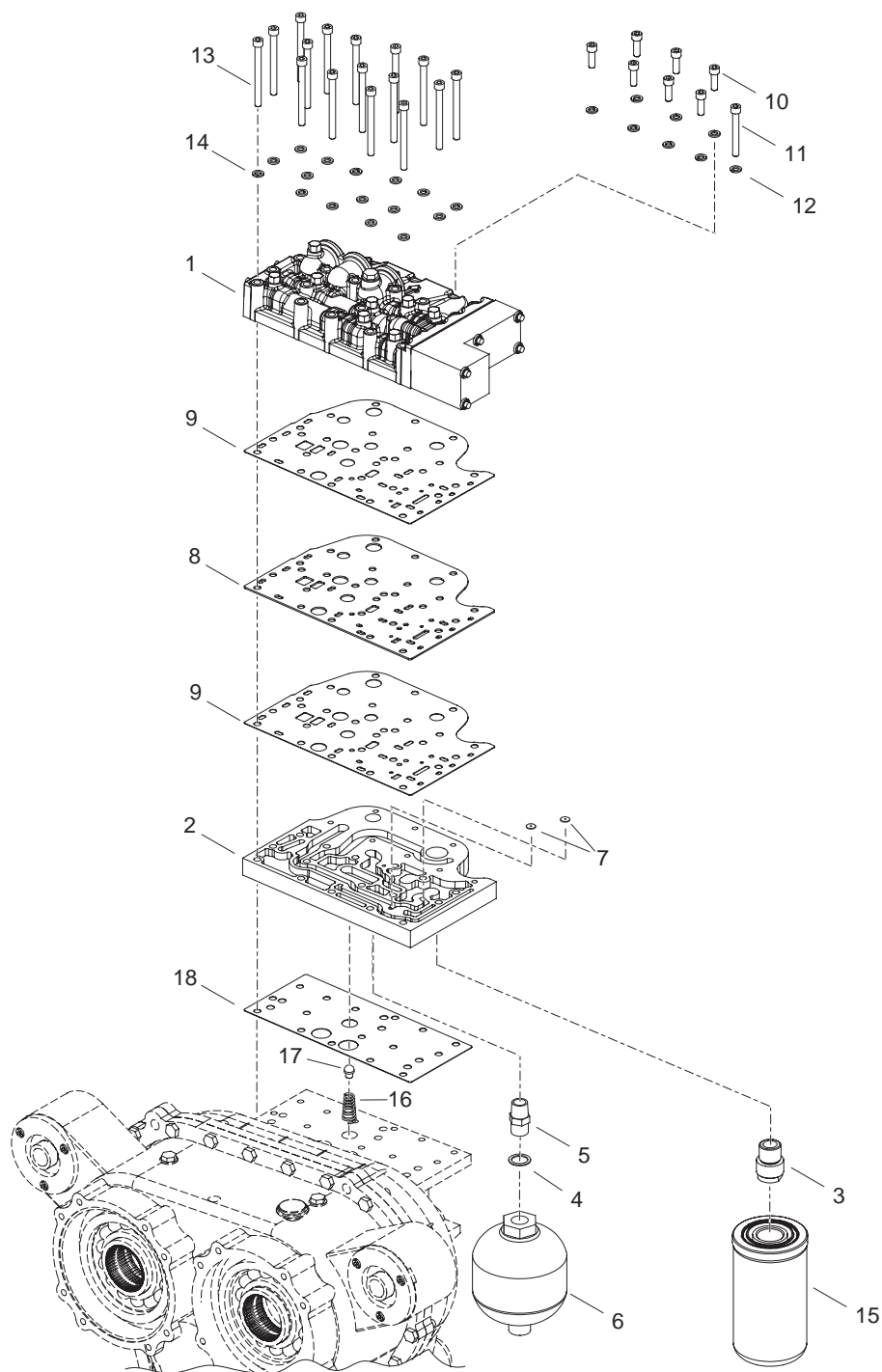


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Shaft - Output	1
2	Snap ring - Output shaft gear	1
3	Gear - Output shaft	1
4	Washer - Output shaft front bearing thrust	1
5	Bearing - Output shaft rear	1
6	Bearing - Output shaft front	1
7	Flange - Output shaft front	1
8	O-ring - Output flange	1
9	Washer - Output flange	1
10	Nut - Output flange	1
11	Flange - Output shaft rear	1
12	O-ring - Output flange	1
13	Washer - Output flange	1
14	Nut - Output flange	1

SECTIONAL VIEWS AND PARTS IDENTIFICATION

GROUP - CONTROL VALVE AND MOUNTING PARTS

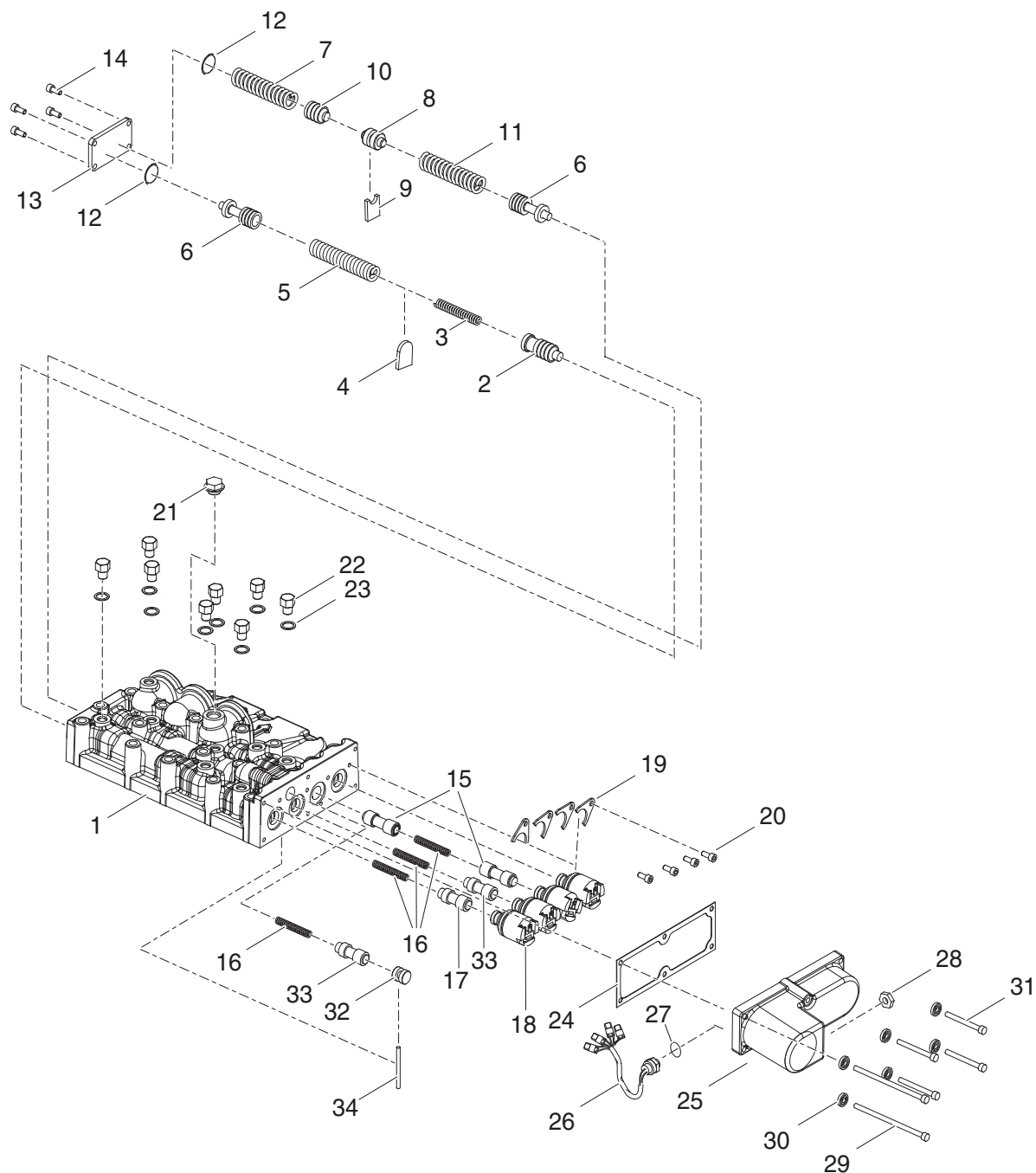


SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Assembly - Control valve	1
2	Plate - Adaptor	1
3	Adaptor - Filter	1
4	Ring - Sealing	1
5	Nipple	1
6	Accumulator	1
7	Plug - restriction	2
8	Plate - Spacer	1
9	Gasket - Spacer plate	2
10	Screw - Control valve to adaptor plate	7
11	Screw -Control valve to adaptor plate	1
12	Lock washer - Control valve to adaptor plate screw	8
13	Screw - Control valve to transmission case	16
14	Lock washer - Control valve to transmission case screw	16
15	Assembly - Filter	1
16	Spring - Safety valve	1
17	Poppet - Safety valve	1
18	Gasket - Spacer plate to transmission case	1

SECTIONAL VIEWS AND PARTS IDENTIFICATION

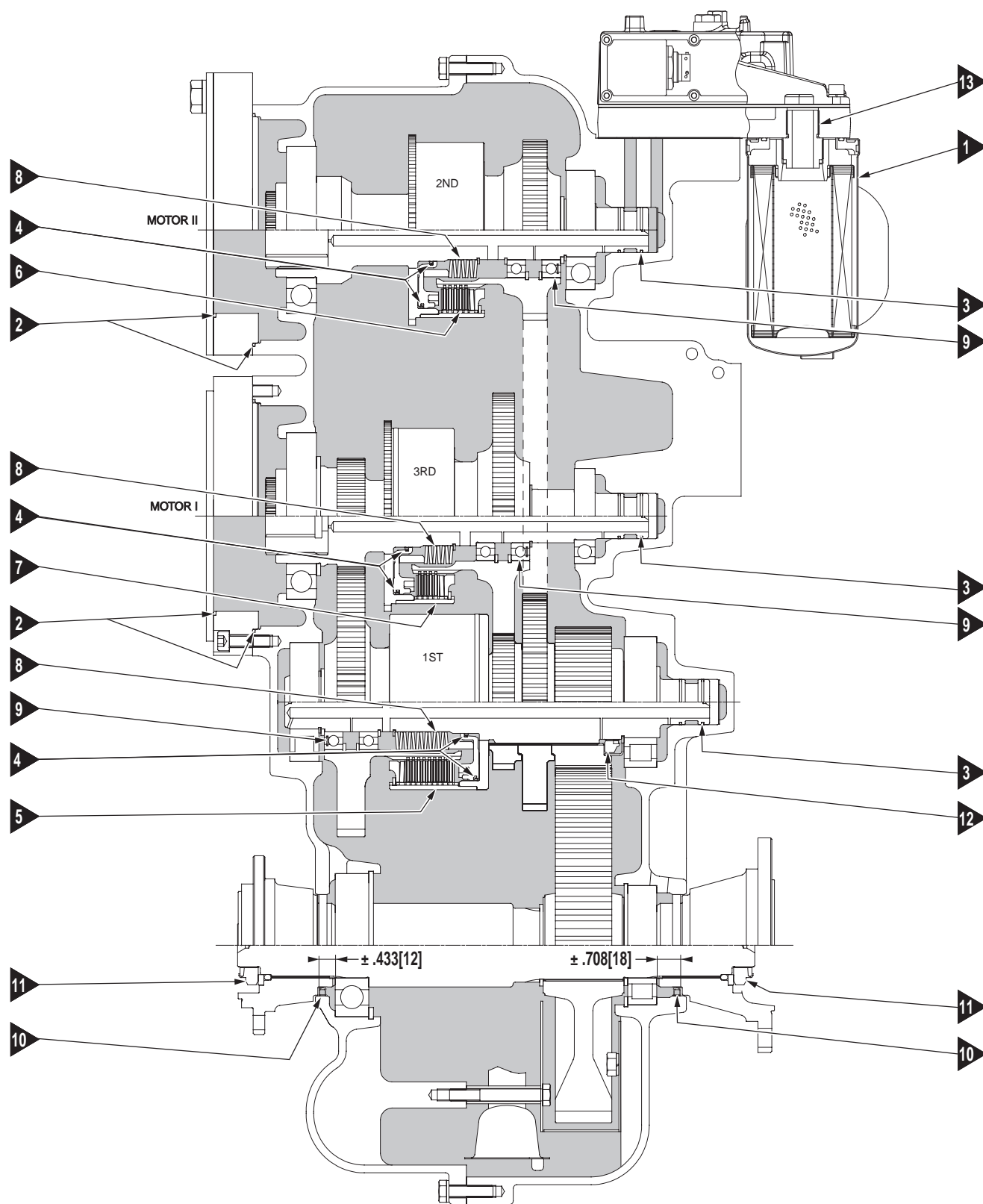
GROUP - CONTROL VALVE



SECTIONAL VIEWS AND PARTS IDENTIFICATION

ITEM	DESCRIPTION	QTY
1	Body - Spool	1
2	Spool - Pressure reducer	1
3	Spring - Pressure reducer	1
4	Plate - Separator	1
5	Spring - Regulator	1
6	Spool - Regulator	2
7	Spring - Lube regulator and filter bypass	1
8	Stop - Spool	1
9	Plate - Separator	1
10	Spool - Accumulator	1
11	Spring - Lube regulator and filter bypass	1
12	O-ring - Spool cover	2
13	Cover - Spool	1
14	Screw - Spool cover	4
15	Spool - Reverse and forward	2
16	Spring - Pilot valve	4
17	Spool - 2nd clutch	1
18	Solenoid	4
19	Clamp - Solenoid	4
20	Screw - Clamp	4
21	Plug	1
22	Plug	8
23	O-ring - Plug	8
24	Gasket - Protection cover	1
25	Cover - Protection	1
26	Assembly - Wiring harness	1
27	O-ring	1
28	Nut - Jam	1
29	Screw - Protection cover	2
30	Ring - Protection cover screw sealing	6
31	Screw - Protection cover	4
32	Stop - Spool	1
33	Spool - Range modulation	1
34	Pin	1

ASSEMBLY INSTRUCTIONS



ASSEMBLY INSTRUCTIONS

All lead-in chamfers for oil seals, piston rings and o-rings must be smooth and free from burrs.

Inspect at assembly.

Lubricate all piston ring grooves and o-rings with oil before assembly.

Apply a thin coating of grease between seal lips on lip type seals prior to assembly.

After assembly of parts using Loctite, there must not be any free or excess material which might enter the oil circuit.

1 - Tighten oil filter to 22 - 28 lbs. ft. [30 - 38 N·m]

2 - Add some grease to o-ring before assembly.

3 - Add some grease to piston rings before assembly. Slots of piston rings is not allowed to pass bores in housings.

4 - Teflon seals must be sized prior to assembly. Add some grease to inner and outer diameter of clutch drum before assembly.

5 - 1st clutch; 9 separator plates with inner splines.

8 friction plates (friction material on both sides) with outer splines.

2 1-side friction plates (friction material on 1 side) with outer splines.

Start with one 1-side friction plate, metal against piston, then alternately separator and friction plate. End with one 1-side friction plate, metal side against end plate or disc spring.

Be sure disc spring is mounted as shown.

Clearance: min. Clearance = 2.68mm max.

Clearance = 5.87mm

If clearance is more than 4.74 mm, add one separator plate upon last separator plate.

6 - 2nd clutch; 5 separator plates,

4 friction plates and two 1-side friction plates.

Assembly see item 5.

Clearance: min. Clearance = 1.47mm max.

Clearance = 3.78mm

If clearance is more than 3.53mm, add one separator plate upon last separator plate.

7 - 3rd clutch; 4 separator plates,

3 friction plates and two 1-side friction plates.

Assembly see item 5.

Clearance: min. Clearance = 1.18mm max.

Clearance = 3.27mm

If clearance is more than 3.24mm, add one separator plate upon last separator plate.

WARNING



Installation force of disc springs is 4410N !

8 - Clutch spring concave side of first disc spring to be placed against clutch piston wear sleeve. Remaining springs to be stacked alternately reversed as shown.

9 - Be sure shielded and sealed bearings are mounted as shown.

10 - Seals must be pressed in perpendicular upon axis from bearing side.

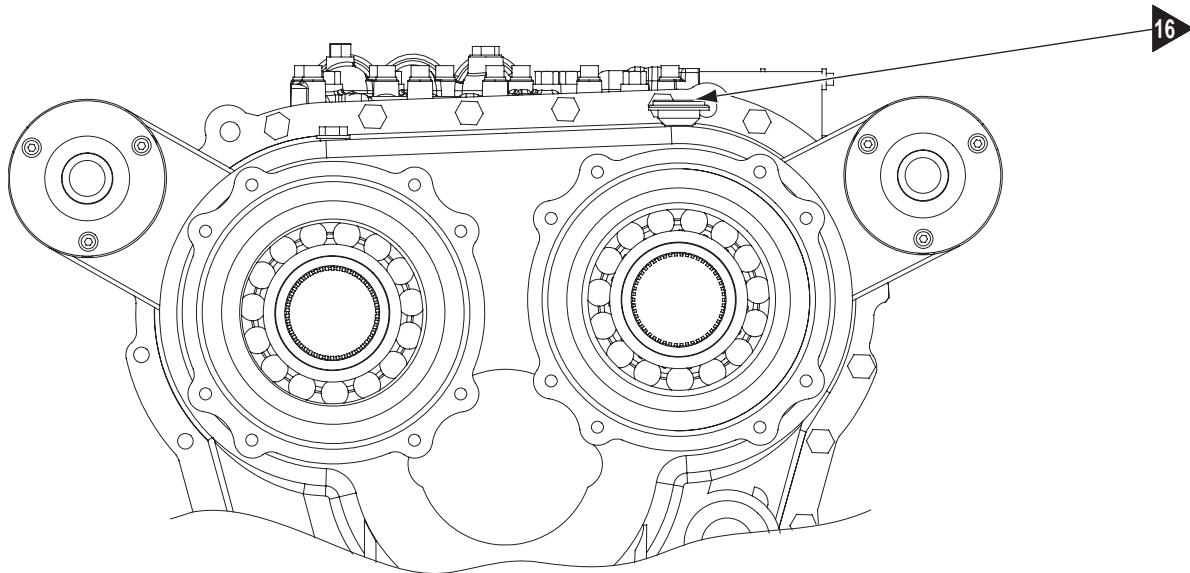
11 - Tighten output flange nut to 250 - 300 lbs. ft. [339 - 407 N·m].

12 - Tighten gear retaining nut to 125 - 147 lbs. ft. [170 - 200 N·m]

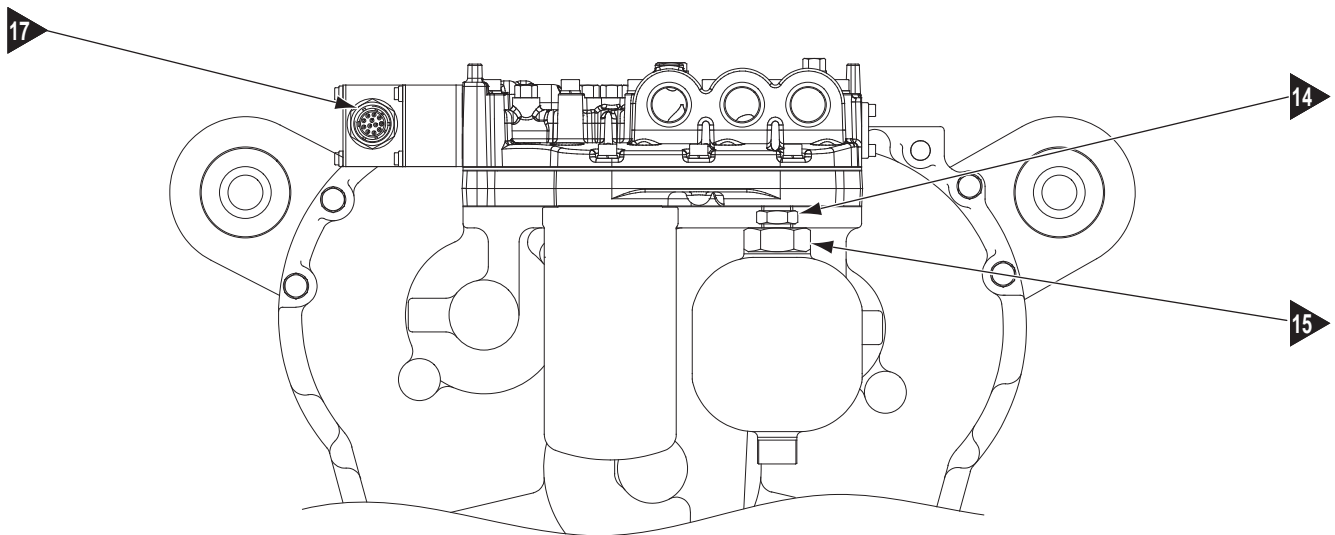
13 - Apply Loctite 243 to thread of filter adaptor and tighten adaptor to 45 - 50 lbs. ft. [61 - 68 N·m]

ASSEMBLY INSTRUCTIONS

FRONT VIEW



REAR VIEW



14 - Apply Loctite 243 to thread of accumulator nipple and tighten to 30 - 35 lbs. ft. [41 - 47 N·m].

15 - Tighten accumulator to 30 - 35 lbs. ft. [41 - 47 N·m].

16 - Tighten air breather to 25 - 30 lbs. ft. [34 - 41 N·m].

17 - Tighten wiring harness nut to 4 - 6 lbs. ft. [6 - 8 N·m].

DISASSEMBLY AND REASSEMBLY

WARNING



Use caution when installing snap rings.
Failure to comply can cause personal injury.

DISASSEMBLY OF TRANSMISSION CASE



FIGURE 1: Remove filter element.

NOTE:

It is recommended a small pan be used to catch the remaining oil.



FIGURE 2: Remove accumulator.



FIGURE 3: Remove control valve screws and lock washers (16).

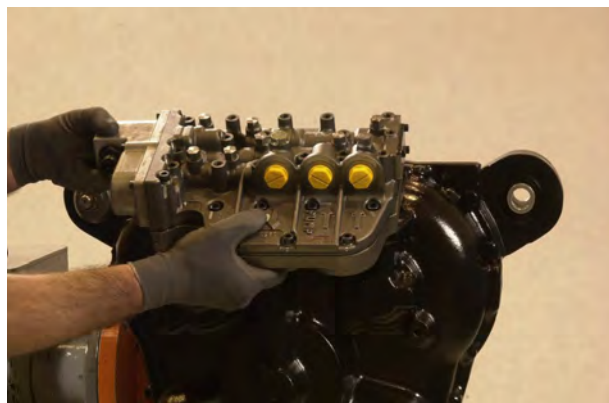


FIGURE 4: Control valve assembly removed.

NOTE:

Use caution to not lose the safety valve spring and poppet.



FIGURE 5: Remove safety valve and poppet.

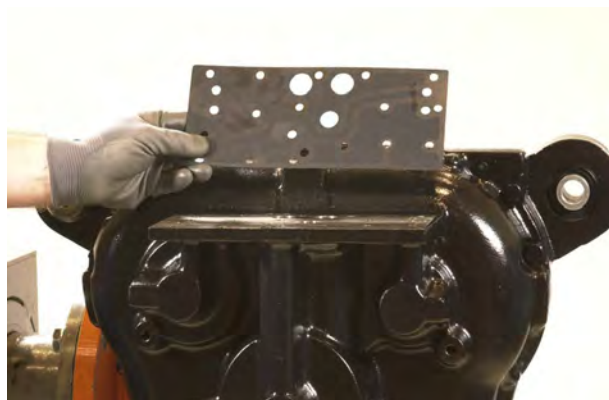


FIGURE 6: Remove control valve to case gasket.

DISASSEMBLY OF TRANSMISSION CASE



FIGURE 7: Use an impact wrench, if available, to loosen output flange nut.
If impact wrench is not available, use flange retainer bar to prevent companion flange from turning.



FIGURE 10: Use an impact wrench, if available, to loosen output flange nut.
If impact wrench is not available, use flange retainer bar to prevent companion flange from turning.

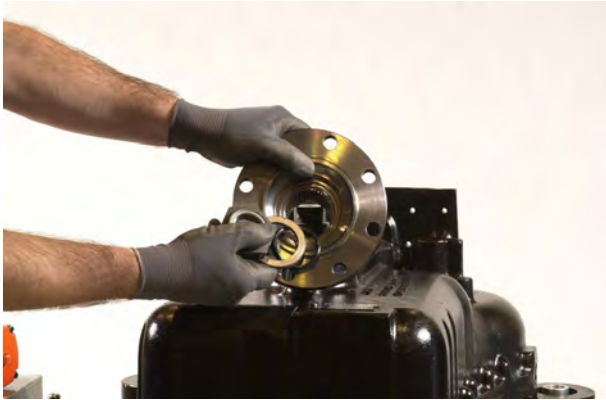


FIGURE 8: Remove output flange (rear), o-ring, washer and nut.

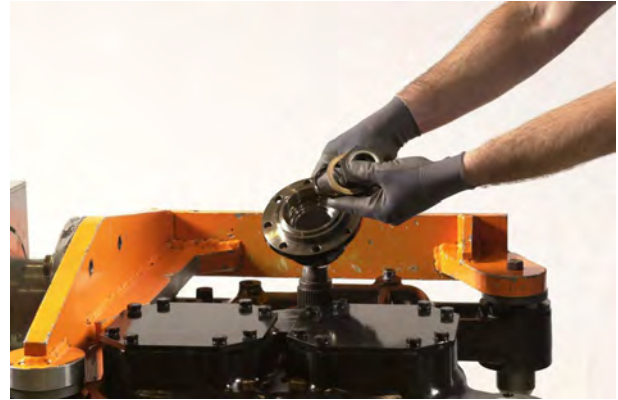


FIGURE 11: Remove output flange (front), o-ring, washer and nut.



FIGURE 9: Remove output spacer.



FIGURE 12: Remove output spacer.

DISASSEMBLY OF TRANSMISSION CASE

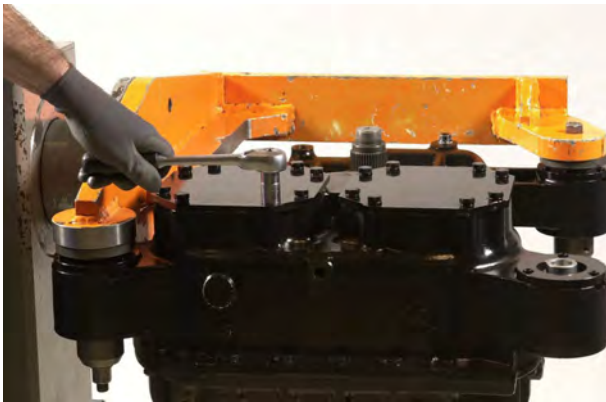


FIGURE 13: Remove cover screws and lock washers.



FIGURE 16: Remove dowel pins.



FIGURE 14: Remove covers and o-rings.



FIGURE 17: Using pry slots provided, pry transmission case from motor case, tapping on the output shaft.



FIGURE 15: Support transmission case with a chain hoist. Remove transmission case to motor case screws and lock washers.

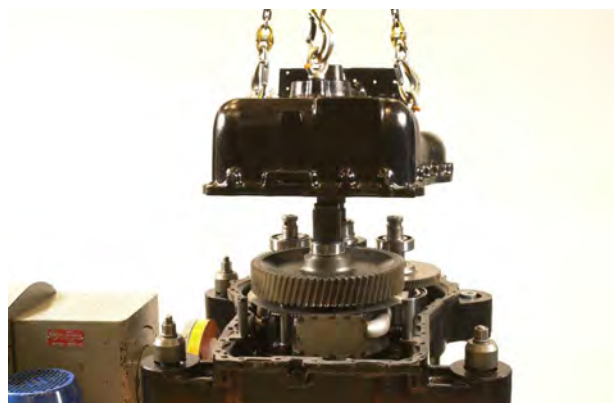


FIGURE 18: Lift transmission case from motor case. All drums and shafts remain in motor case.

DISASSEMBLY OF TRANSMISSION CASE

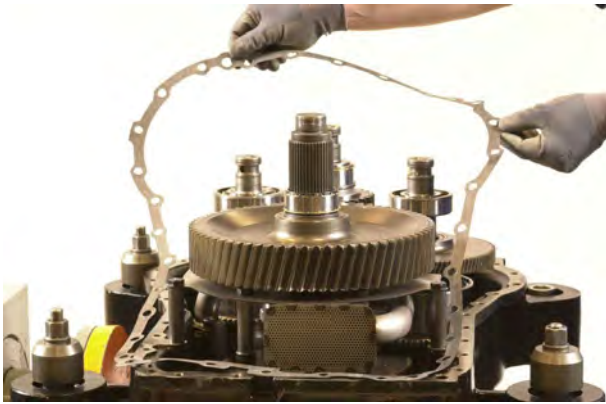


FIGURE 19: Remove transmission case gasket



FIGURE 22: Baffle plate, screws, and spacers removed.



FIGURE 20: Use bearing puller to remove output gear and rear bearing inner race.



FIGURE 23: Remove suction tube screws and lock washers.



FIGURE 21: Remove baffle plate mounting screws and lock washers.



FIGURE 24: Remove suction tube and o-ring.

DISASSEMBLY OF TRANSMISSION CASE



FIGURE 25: Remove output shaft front bearing locating ring.



FIGURE 28: Remove snap ring retainer.



FIGURE 26: Remove output shaft and front bearing.



FIGURE 29: Remove low clutch shaft rear bearing snap ring.



FIGURE 27: Remove 1st clutch shaft rear bearing inner race.



FIGURE 30: Remove low clutch shaft seal rings.

DISASSEMBLY OF TRANSMISSION CASE



FIGURE 31: Remove retainer nut. Use special tool ASHY 20 - Gear Retainer Nut Socket p. 98.



FIGURE 34: Remove 2nd driven gear.

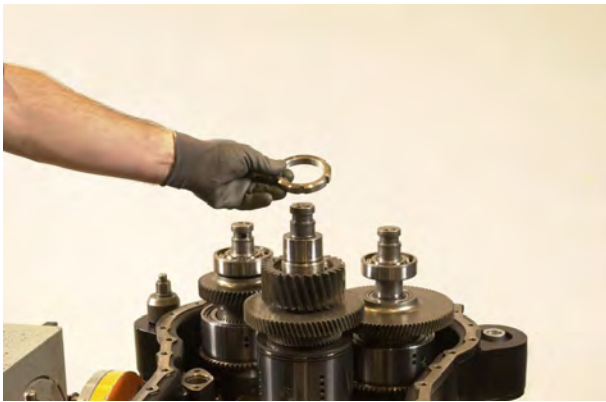


FIGURE 32: Retainer nut removed.



FIGURE 35: Remove 3rd driven gear.



FIGURE 33: Remove output drive gear.



FIGURE 36: Lift 1st shaft to be able to remove 2nd and 3rd clutch.

DISASSEMBLY OF TRANSMISSION CASE



FIGURE 37: Remove oil baffle screws and lock washers.



FIGURE 40: If output shaft rear bearing has to be replaced, remove bearing retaining ring.



FIGURE 38: Remove oil baffle.



FIGURE 39: Remove 1st shaft rear bearing outer race from transmission case.

DISASSEMBLY LOW (1ST) CLUTCH

DISASSEMBLY LOW (1ST) CLUTCH



FIGURE 41: Using puller, remove low shaft front bearing inner race.



FIGURE 42: Low shaft front bearing inner race removed.



FIGURE 43: Remove front bearing retainer ring.



FIGURE 44: Remove clutch gear outer bearing thrust washer.



FIGURE 45: Remove clutch gear and outer bearing.



FIGURE 46: Clutch gear and outer bearing removed.

DISASSEMBLY LOW (1ST) CLUTCH



FIGURE 47: Remove clutch gear inner bearing.



FIGURE 50: Remove backing plate.



FIGURE 48: Remove inner bearing retaining ring.



FIGURE 51: Remove modulating spring.



FIGURE 49: Remove backing ring plate retaining ring.



FIGURE 52: Remove one (1) outer half disc.

DISASSEMBLY LOW (1ST) CLUTCH



FIGURE 53: Remove inner and outer discs.



FIGURE 56: Remove Belleville washer disc springs.

NOTE:

Do not mix disc springs with any other disc springs as they are matched spring packs.



FIGURE 54: Remove outer half disc.



FIGURE 57: Remove clutch piston wear sleeve.



FIGURE 55: Compress clutch piston Belleville washer spring and remove snap ring.



FIGURE 58: Remove clutch piston.

WARNING



Use caution when installing snap rings.
Failure to comply can cause personal injury.

REASSEMBLY LOW (1ST) CLUTCH



FIGURE 59: Refer to CLEANING AND INSPECTION p. 8. The bleed hole in the piston must be clean and free of any foreign material. Install clutch piston outer seal.

NOTE:

Ring must be sized before installing in the clutch drum. Sizing is best accomplished by rotating clutch piston while holding a round object against the new sealing ring. Rotate piston until seal is flush with outer diameter of piston.



FIGURE 60: Install clutch piston inner seal and size as described in Figure 59.



FIGURE 61: Position piston in low clutch drum as shown. Use caution as not to damage inner and outer piston sealing rings.



FIGURE 62: Install clutch piston wear sleeve. (See item 8 on page 54).



FIGURE 63: Install piston return springs. First spring with larger diameter of bevel towards wear sleeve. See Figure 65. Alternate thirteen (13) springs. See note Figure 56.

REASSEMBLY LOW (1ST) CLUTCH



FIGURE 64: Compress spring to install spring retainer ring.

NOTE:

Be sure ring is in full position in groove.

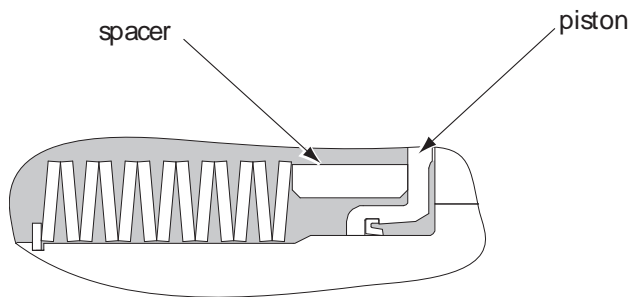


FIGURE 65: Install one (1) outer half clutch disc with friction material away from piston.



FIGURE 66: Install one steel clutch plate. Alternate friction and steel discs until the proper amount of discs are installed.

NOTE:

First and last disc are steel.



FIGURE 67: Install one (1) outer half disc with friction material down.



FIGURE 68: Install modulation spring with large diameter up towards the backing plate.

REASSEMBLY LOW (1ST) CLUTCH



FIGURE 69: Install backing plate.

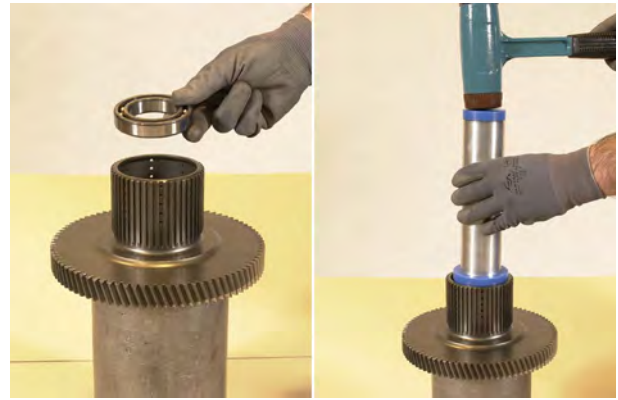


FIGURE 72: Install bearings (2) in gear.



FIGURE 70: Install backing plate retaining ring.

NOTE:

Clutch pack must be checked for clutch disc clearance. See item 5 on page 54.



FIGURE 73: Warm bearings up to 248°F [120°C] and install gear on shaft.

CAUTION

Do not force the operation in this step. Gear splines must be aligned with internal teeth of all friction discs. Failure to comply may cause equipment damage.



FIGURE 71: Install clutch gear inner bearing retaining ring.



FIGURE 74: Install outer bearing thrust washer.

REASSEMBLY LOW (1ST) CLUTCH



FIGURE 75: Install low shaft front bearing retaining ring.



FIGURE 76: Install low shaft front bearing inner race.

DISASSEMBLY 2ND CLUTCH



FIGURE 77: Remove clutch shaft piston rings.



FIGURE 78: Remove clutch shaft rear bearing.



FIGURE 79: Remove clutch shaft rear bearing retaining ring.



FIGURE 80: Remove clutch gear outer bearing thrust washer.



FIGURE 81: Remove clutch gear and outer bearing.



FIGURE 82: Clutch gear and outer bearing removed.

DISASSEMBLY 2ND CLUTCH



FIGURE 83: Remove clutch gear inner bearing.



FIGURE 86: Remove backing plate.



FIGURE 84: Remove clutch gear inner bearing retaining ring.



FIGURE 87: Remove modulation spring.



FIGURE 85: Remove backing plate retaining ring.



FIGURE 88: Remove one (1) outer half disc.

DISASSEMBLY 2ND CLUTCH



FIGURE 89: Remove inner and outer discs.



FIGURE 92: Remove Belleville washer disc springs.
See note in Figure 56



FIGURE 90: Remove one (1) outer half disc.



FIGURE 93: Remove clutch piston wear sleeve.



FIGURE 91: Compress clutch piston Belleville washer spring and remove spring retaining snap ring.



FIGURE 94: Remove clutch piston.

WARNING



Use caution when installing snap rings.
Failure to comply can cause personal injury.

DISASSEMBLY 2ND CLUTCH



FIGURE 95: Remove clutch shaft front bearing.

REASSEMBLY 2ND CLUTCH



FIGURE 96: Refer to CLEANING AND INSPECTION p. 8. The bleed hole in the piston must be clean and free of any foreign material. Install clutch piston outer seal. Size as described in Figure 59.



FIGURE 97: Install clutch piston inner seal and size as described in Figure 59.



FIGURE 98: Position piston in low clutch drum as shown. Use caution as not to damage inner and outer piston sealing rings.



FIGURE 99: Install clutch piston wear sleeve. (See item 8 on page 54).



FIGURE 100: Install piston return springs. First spring with larger diameter of bevel towards wear sleeve. See Figure 106. Alternate seven (7) springs. See note Figure 56.



FIGURE 101: Compress spring to install spring retainer ring.

NOTE:

Be sure ring is in full position in groove.

REASSEMBLY 2ND CLUTCH

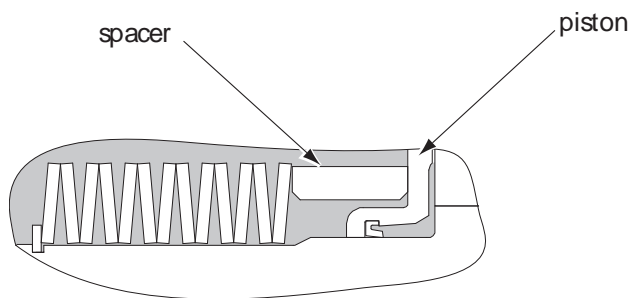


FIGURE 102: Install one (1) half disc with friction material away from piston.



FIGURE 103: Install one (1) steel disc. Alternate friction and steel discs until proper amount of discs is installed.



FIGURE 104: Install one (1) half disc with friction material away from piston.



FIGURE 105: Install modulation spring with large diameter towards the backing plate.



FIGURE 106: Install backing plate.

REASSEMBLY 2ND CLUTCH



FIGURE 107: Install backing plate retaining ring.

NOTE:

Clutch pack must be checked for clutch disc clearance. See item 6 on page 54.



FIGURE 110: Warm bearings up to 248°F [120°C] and install gear on shaft.

CAUTION

Do not force the operation in this step. Gear splines must be aligned with internal teeth of all friction discs. Failure to comply may cause equipment damage.



FIGURE 108: Install clutch gear inner bearing retaining ring.



FIGURE 111: Install outer bearing thrust washer.



FIGURE 109: Install bearings (2) in gear.



FIGURE 112: Install 2nd clutch shaft rear bearing retaining snap ring.

REASSEMBLY 2ND CLUTCH



FIGURE 113: Install 2nd clutch shaft rear bearing and tap bearing into place.



FIGURE 114: Install 2nd clutch shaft sealing rings.



FIGURE 115: Tap 2nd clutch shaft front bearing into place warming up to 248°F [120°C].

DISASSEMBLY 3RD CLUTCH



FIGURE 116: Remove 3rd clutch shaft sealing rings.



FIGURE 119: Remove 3rd clutch bearing retaining ring.



FIGURE 117: Remove 3rd clutch shaft rear bearing.



FIGURE 120: Remove 3rd clutch gear and outer bearing.



FIGURE 118: Remove spacer.



FIGURE 121: Clutch gear and outer bearing removed.

DISASSEMBLY 3RD CLUTCH



FIGURE 122: Remove clutch gear inner bearing.



FIGURE 125: Remove modulation spring.



FIGURE 123: Remove backing plate retaining ring.



FIGURE 126: Remove one (1) outer half disc.



FIGURE 124: Remove backing plate.



FIGURE 127: Remove inner and outer discs.

DISASSEMBLY 3RD CLUTCH



FIGURE 128: Remove one (1) outer half disc.



FIGURE 131: Remove clutch piston wear sleeve.



FIGURE 129: Compress clutch piston bellville washer spring and remove spring snap ring.



FIGURE 132: Remove clutch piston.

⚠ WARNING	
	Use caution when installing snap rings. Failure to comply can cause personal injury.



FIGURE 130: Remove bellville washer disc springs.
See note in Figure 56.



FIGURE 133: Remove 3rd clutch shaft front bearing.

DISASSEMBLY 3RD CLUTCH



FIGURE 134: Remove 3rd clutch shaft front bearing thrust washer.

REASSEMBLY 3RD CLUTCH



FIGURE 135: Refer to CLEANING AND INSPECTION p. 8. The bleed hole in the piston must be clean and free of any foreign material. Install clutch piston outer seal. Size as described in Figure 59.



FIGURE 136: Install clutch piston inner seal and size as described in Figure 59.



FIGURE 137: Position piston in low clutch drum as shown. Use caution as not to damage inner and outer piston sealing rings.



FIGURE 138: Install clutch piston wear sleeve. (See item 8 on page 54).



FIGURE 139: Install piston return springs. First spring with larger diameter of bevel towards wear sleeve. See Figure 106. Alternate seven (7) springs. See note Figure 56.

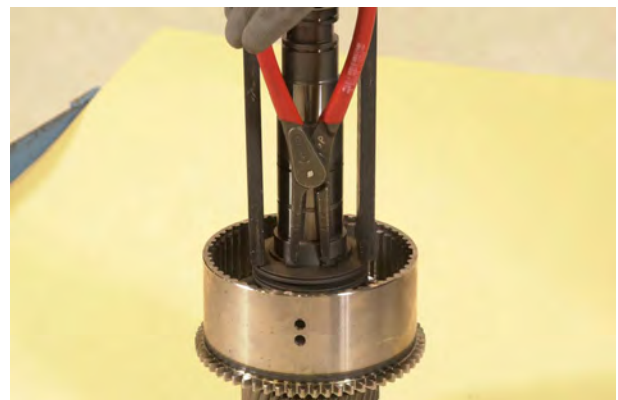


FIGURE 140: Compress spring to install spring retainer ring.

NOTE:

Be sure ring is in full position in groove.

REASSEMBLY 3RD CLUTCH

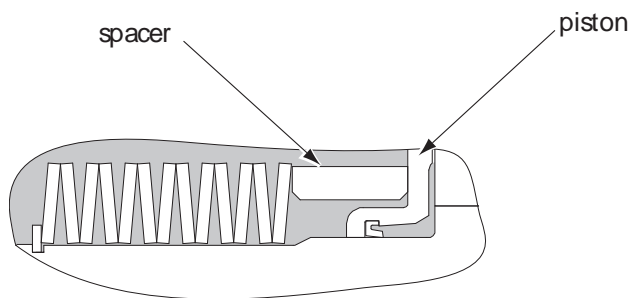


FIGURE 141: Install one (1) outer half disc with friction material away from piston.



FIGURE 142: Install one (1) steel disc. Alternate friction and steel discs until proper amount of discs are installed. First and last disc are steel.



FIGURE 143: Install one (1) outer half disc with friction material down.



FIGURE 144: Install modulation spring with large diameter up to the backing plate.



FIGURE 145: Install backing plate.

REASSEMBLY 3RD CLUTCH



FIGURE 146: Install backing plate retaining ring.

NOTE:

Clutch pack must be checked for clutch disc clearance. See item 7 on page 54.



FIGURE 149: Install 3rd clutch gear outer bearing retaining ring.

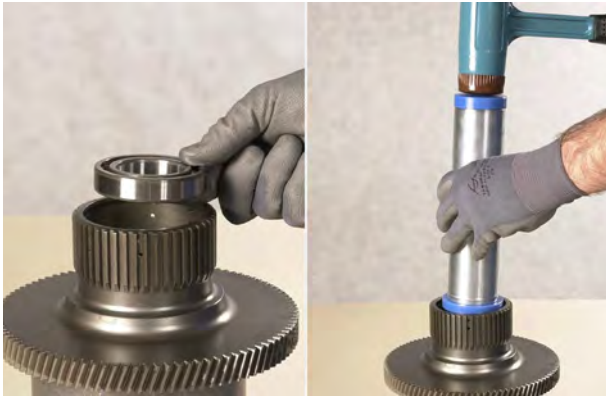


FIGURE 147: Install bearings (2) in gear.



FIGURE 150: Install spacer.



FIGURE 148: Warm bearings up to 248°F [120°C] and install gear on shaft.



FIGURE 151: Install 3rd clutch shaft rear bearing.

CAUTION

Do not force the operation in this step. Gear splines must be aligned with internal teeth of all friction discs. Failure to comply may cause equipment damage.

REASSEMBLY 3RD CLUTCH



FIGURE 152: Install 3rd clutch shaft sealing rings.



FIGURE 153: Install 3rd clutch shaft front bearing thrust washer.



FIGURE 154: Install 3rd clutch shaft front bearing.

REASSEMBLY OF TRANSMISSION CASE

REASSEMBLY OF TRANSMISSION CASE



FIGURE 155: Install output shaft rear bearing outer race.



FIGURE 156: Install output shaft rear bearing outer race retaining ring.



FIGURE 157: Position new output shaft rear oil seal in transmission case.
See item 10 on page 54.

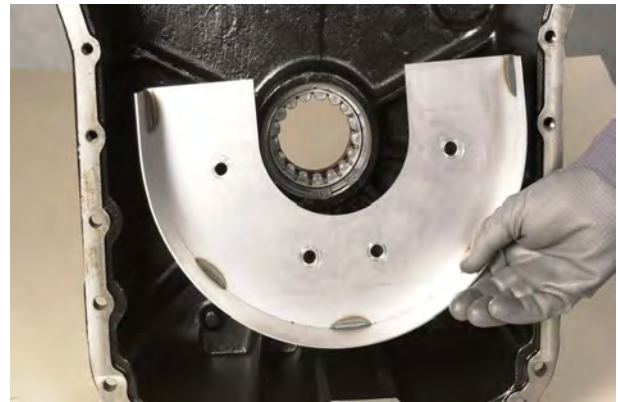


FIGURE 158: Position oil baffle into transmission case.

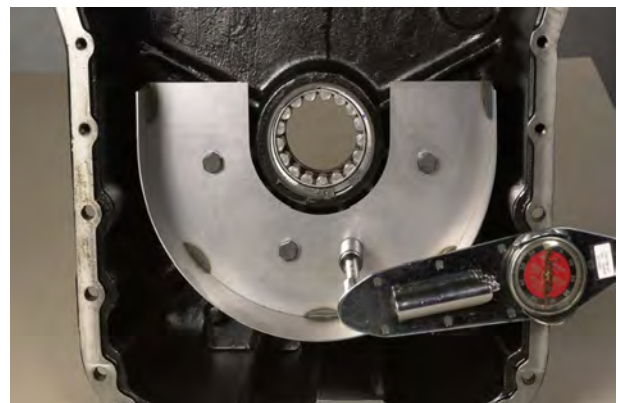


FIGURE 159: Install oil baffle screws and lock washers. Tighten screws to specified torque (see TORQUE SPECIFICATIONS p. 95).



FIGURE 160: Install low shaft gear bearing outer race.

REASSEMBLY OF TRANSMISSION CASE



FIGURE 161: Position new output shaft front oil seal in motor case.
See item 10 on page 54.



FIGURE 164: Install 3rd driven gear with counter bore up.



FIGURE 162: Install 1st (low) shaft assembly into motor case.



FIGURE 165: Install 2nd driven gear.



FIGURE 163: Install 2nd and 3rd shaft assembly into motor case at the same time.



FIGURE 166: Install output drive gear with counter bore up.

REASSEMBLY OF TRANSMISSION CASE

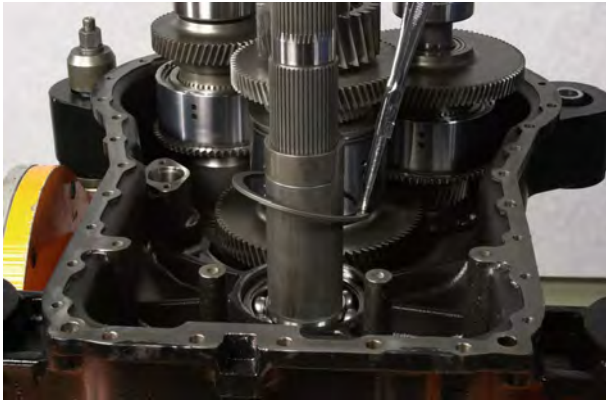


FIGURE 167: Install output shaft and secure with output shaft front bearing retaining ring.



FIGURE 170: Install baffle plate, screws, spacers, and lock washers.



FIGURE 168: Install suction tube with new o-ring.



FIGURE 171: Tighten screws to specified torque.
(See TORQUE SPECIFICATIONS p. 95)



FIGURE 169: Install suction tube screws and lock washers.
Tighten to specified torque. (See TORQUE SPECIFICATIONS p. 95).



FIGURE 172: Install output shaft gear.

REASSEMBLY OF TRANSMISSION CASE



FIGURE 173: Install gear retaining nut using Loctite 243.



FIGURE 176: Install retaining ring spacer.



FIGURE 174: Tighten gear retaining nut to 125 - 147 lbs. ft. [170 - 200 N·m] (See item 12 on page 63) using ASHY 20 - Gear Retainer Nut Socket p. 98.



FIGURE 177: Install low shaft gear bearing inner race warming up to 248°F [120°C].



FIGURE 175: Install retaining ring.



FIGURE 178: Install piston rings (2).

REASSEMBLY OF TRANSMISSION CASE



FIGURE 179: Install output shaft gear retaining ring.

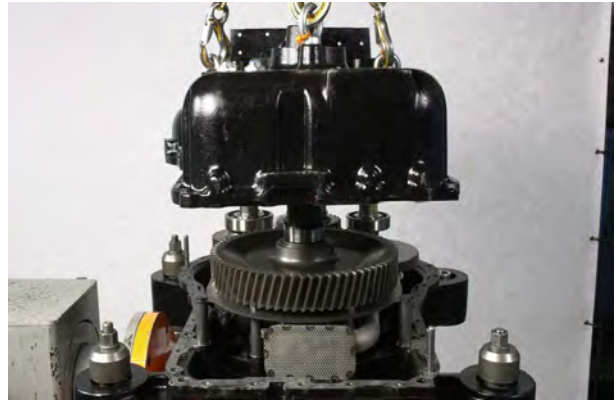


FIGURE 182: The use of two (2) aligning studs will facilitate aligning the transmission case to the motor case.



FIGURE 180: Install output shaft gear bearing inner race warming up to 248°F [120°C].



FIGURE 183: Align clutch shaft bearings with bearing bores in the case housing. Tap lightly in place. Use caution as not to damage oil sealing rings. Remove aligning studs.



FIGURE 181: Position new gasket on motor case. A thin coat of chassis grease will hold the gasket in place.



FIGURE 184: Install dowel pins (2).

REASSEMBLY OF TRANSMISSION CASE



FIGURE 185: Install case to case screws and lockwashers. Tighten screws to specified torque. (See TORQUE SPECIFICATIONS p. 95).



FIGURE 188: Install rear output flange o-ring, washer, and locknut.



FIGURE 186: Install output shaft flange.

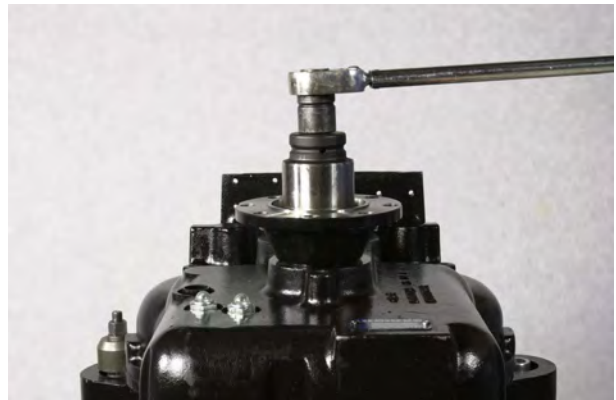


FIGURE 189: Tighten output shaft flange locknut to 250 - 300 lbs. ft. [339 - 407 N·m]. (See item 11 on page 54).



FIGURE 187: Install output front spacer.

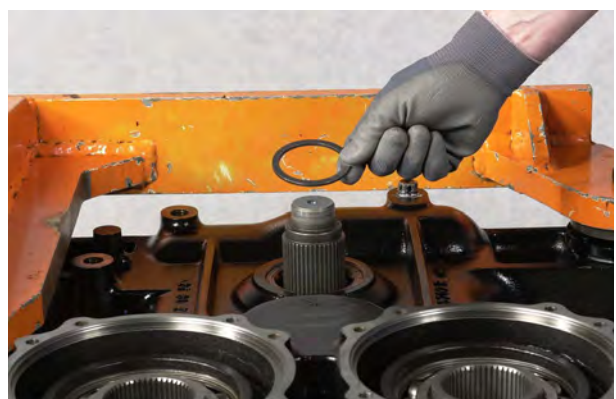


FIGURE 190: Install output front spacer.

REASSEMBLY OF TRANSMISSION CASE



FIGURE 191: Install front output flange.



FIGURE 194: Install o-rings and covers.



FIGURE 192: Install front output flange o-ring, washer, and locknut.

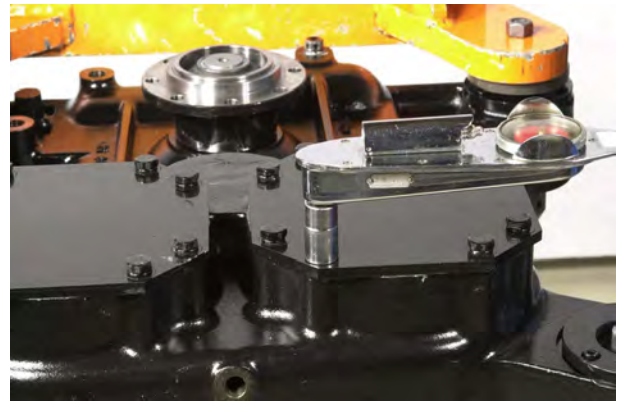


FIGURE 195: Install cover screws and lock washers. Tighten to specified torque. (See TORQUE SPECIFICATIONS p. 95).



FIGURE 193: Tighten output shaft flange nut to 250 - 300 lbs. ft. [339 - 407 N·m]. (See item 11 on page 54).

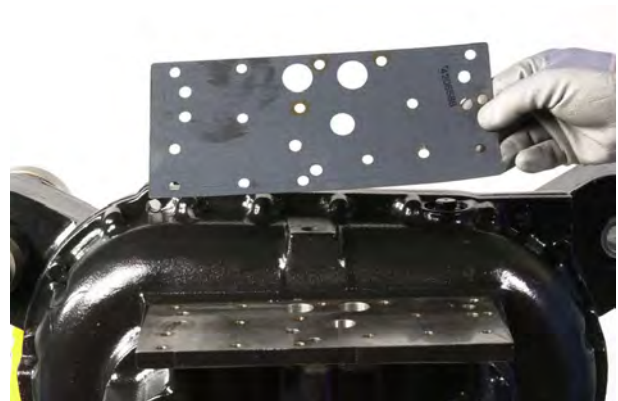


FIGURE 196: Install valve to case gasket.

REASSEMBLY OF TRANSMISSION CASE



FIGURE 197: Position safety valve spring and poppet.



FIGURE 198: Use alignment studs to install valve assembly to housing. Use caution as not to damage safety valve spring and poppet.

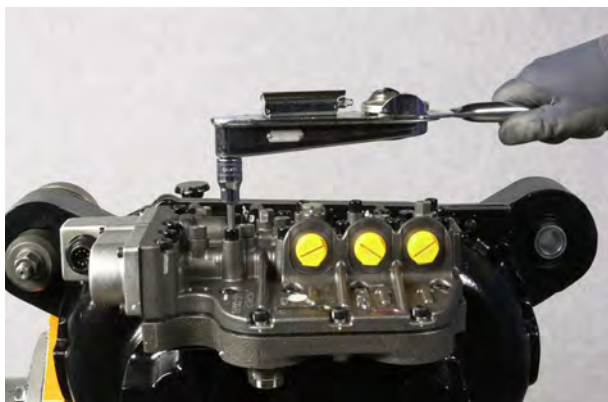


FIGURE 199: Install screws (16) and lock washers. Tighten to specified torque. (See TORQUE SPECIFICATIONS p. 95).



FIGURE 200: Position new sealing ring in accumulator. Install accumulator with Loctite 243 to filter adapter and tighten to 45 - 50 lbs. ft. [61 - 68 N·m]. (See item 13 on page 54).



FIGURE 201: Install new oil filter. Tighten filter to 22 - 28 lbs. ft. [30 - 38 N·m]. (See item 1 on page 54).

TORQUE SPECIFICATIONS

LUBRICATED OR PLATED SCREW

COARSE PITCH

SIZE OF BOLT	TYPE OF BOLT			
	Grade 5		Grade 8	
	lbs. ft.	N•m	lbs. ft.	N•m
.2500	8 - 10	10.8 - 13.6	9 - 11	12.2 - 14.9
.3125	12 - 16	16.3 - 21.7	26 - 30	35.2 - 40.7
.3750	23 - 25	31.2 - 33.9	33 - 36	44.7 - 48.8
.4375	37 - 41	50.2 - 55.6	52 - 57	70.5 - 77.3
.5000	57 - 63	77 - 85	80 - 88	108 - 119
.5625	82 - 90	111 - 122	115 - 127	156 - 172
.6250	113 - 124	153 - 168	159 - 175	216 - 237
.7500	200 - 220	271 - 298	282 - 310	382 - 420

FINE PITCH

SIZE OF BOLT	TYPE OF BOLT			
	Grade 5		Grade 8	
	lbs. ft.	N•m	lbs. ft.	N•m
.2500	9 - 11	12.2 - 14.9	11 - 13	14.9 - 17.6
.3125	16 - 20	21.7 - 27.1	28 - 32	38.0 - 43.4
.3750	26 - 29	35.2 - 39.3	37 - 41	50.2 - 55.6
.4375	41 - 45	56 - 61	58 - 64	79 - 87
.5000	64 - 70	87 - 95	90 - 99	122 - 134
.5625	91 - 100	123 - 136	128 - 141	174 - 191
.6250	129 - 141	174 - 191	180 - 198	224 - 268
.7500	223 - 245	302 - 332	315 - 347	427 - 470

LUBRICATED OR PLATED SCREW

COARSE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	Grade 8.8		Grade 10.9		Grade 12.9	
	lbs. ft.	N•m	lbs. ft.	N•m	lbs. ft.	N•m
M5 x 0.8	3.7 - 4.4	5 - 6	5.2 - 5.9	7 - 8	5.9 - 7.4	8 - 10
M6 x 1	5.9 - 7.4	8 - 10	8.9 - 11.1	12 - 15	9.6 - 11.8	13 - 16
M8 x 1.25	14.8 - 18.4	20 - 25	22.1 - 25.8	30 - 35	25.8 - 29.5	35 - 40
M10 x 1.5	29.5 - 36.9	40 - 50	44.3 - 47.9	60 - 65	47.9 - 55.3	65 - 75
M12 x 1.75	50 - 55	68 - 75	74 - 81	100 - 110	85 - 96	115 - 130
M14 x 2	81 - 92	110 - 125	111 - 129	150 - 175	133 - 155	180 - 210
M16 x 2	125 - 140	170 - 190	177 - 203	240 - 275	207 - 236	280 - 320
M20 x 2.5	236 - 266	320 - 360	332 - 369	450 - 500	387 - 443	525 - 600
M24 x 3	420 - 479	570 - 650	590 - 664	800 - 900	664 - 774	900 - 1050
M30 x 3.5	848 - 959	1150 - 1300	1180 - 1328	1600 - 1800	1364 - 1549	1850 - 2100
M36 x 4	1475 - 1660	2000 - 2250	2028 - 2323	2749 - 3149	2397 - 2729	3249 - 3699

FINE PITCH

SIZE OF BOLT	TYPE OF BOLT					
	Grade 8.8		Grade 10.9		Grade 12.9	
	lbs. ft.	N•m	lbs. ft.	N•m	lbs. ft.	N•m
M8 x 1	17 - 20	23 - 28	25 - 28	34 - 39	30 - 34	41 - 46
M10 X 1	35 - 42	47 - 57	52 - 60	71 - 81	62 - 69	84 - 94
M10 x 1,25	32 - 40	44 - 54	49 - 57	67 - 77	58 - 66	79 - 89
M12 x 1,25	60 - 68	82 - 92	89 - 96	120 - 130	105 - 116	143 - 158
M12 x 1,5	58 - 65	78 - 88	86 - 94	117 - 127	101 - 112	138 - 153
M14 x 1,5	94 - 105	128 - 143	142 - 153	193 - 208	162 - 184	220 - 250
M16 x 1,5	159 - 169	215 - 228	216 - 227	293 - 308	258 - 273	350 - 370
M18 x 1,5	221 - 236	300 - 320	319 - 330	433 - 448	369 - 398	500 - 540
M18 x 2	207 - 221	280 - 300	304 - 315	413 - 428	347 - 376	470 - 510
M20 x 1,5	302 - 332	410 - 450	439 - 476	595 - 645	503 - 559	683 - 758
M22 x 1,5	413 - 443	560 - 600	586 - 623	795 - 845	681 - 736	923 - 998
M24 x 1,5	531 - 590	720 - 800	767 - 841	1040 - 1140	882 - 992	1195 - 1345
M24 x 2	509 - 568	690 - 770	730 - 804	990 - 1090	845 - 955	1145 - 1295
M27 x 1,5	789 - 848	1070 - 1150	1129 - 1202	1530 - 1630	1308 - 1420	1175 - 1925

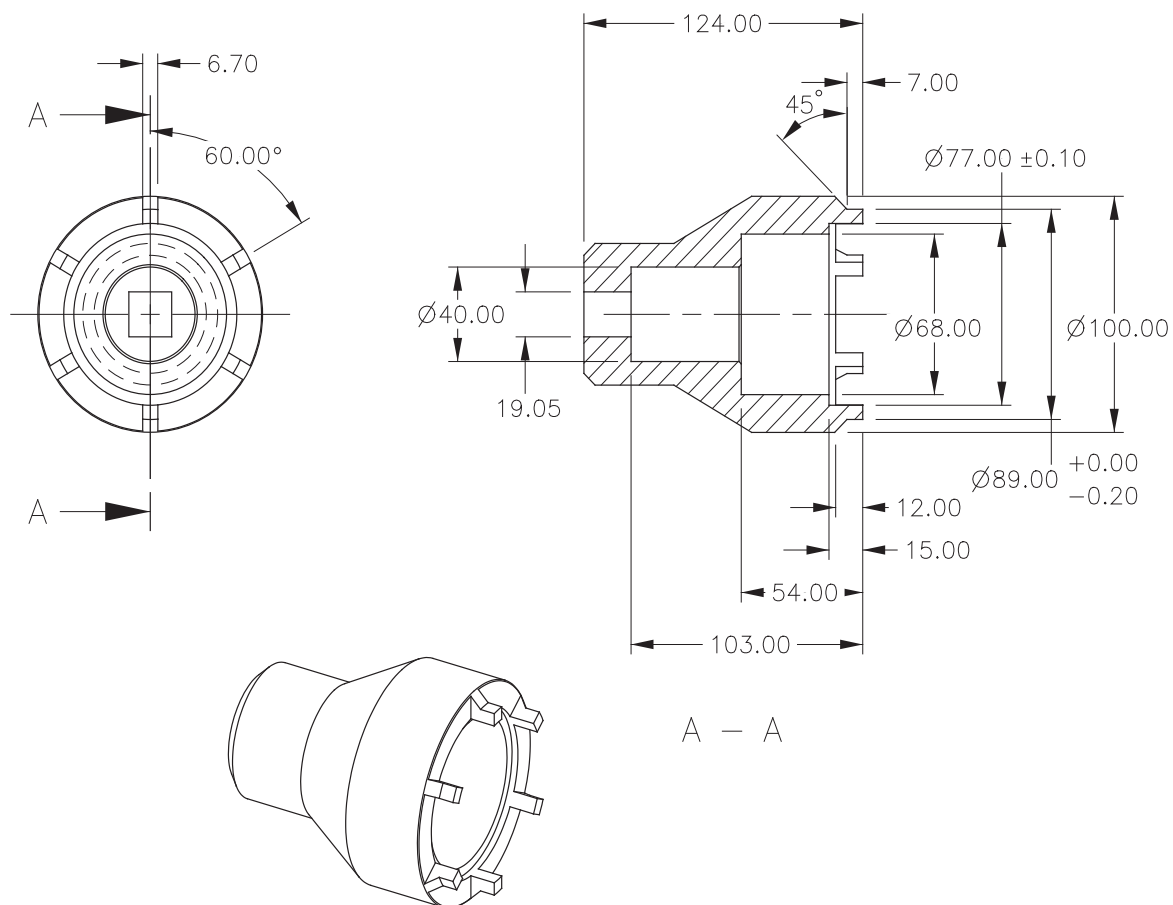
PIPE PLUGS

THREAD SIZE	lbs. ft.	N·m
M10 x 1	6 - 7	8 - 10
M14 x 1.5	7 - 9	10 - 12
M18 x 1.5	25 - 30	34 - 41
M22 x 1.5	35 - 44	48 - 60
M26 x 1.5	45 - 50	61 - 68
M33 x 2	83 - 103	112 - 140

THREAD SIZE	lbs. ft.	N·m
1/16 - 27	5 - 7	7 - 9
1/8 - 27	7 - 10	9 - 14
1/4 - 18	15 - 20	20 - 27
5/16 - 24	3 - 5	4 - 7
3/8 - 24	5 - 8	7 - 11
3/8 - 18	25 - 30	34 - 41
1/2 - 14	30 - 35	41 - 47
1/2 - 20	10 - 13	14 - 18
3/4 - 10	40 - 45	54 - 61
3/4 - 14	40 - 45	54 - 61
7/16 - 20	7 - 10	9 - 14
9/16 - 18	12 - 15	16 - 20
3/4 - 16	20 - 25	27 - 34
7/8 - 14	30 - 35	41 - 47
11/16 - 12	45 - 50	61 - 68
15/16 - 12	65 - 75	88 - 102
1 - 11-1/2	50 - 55	68 - 75
1-1/4 - 11-1/2	60 - 65	81 - 88
1-5/8 - 12	75 - 85	102 - 115
1-7/8 - 12	75 - 85	102 - 115

SPECIAL TOOLS

ASHY 20 - GEAR RETAINER NUT SOCKET



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